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EST. 1902

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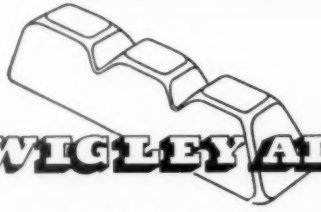

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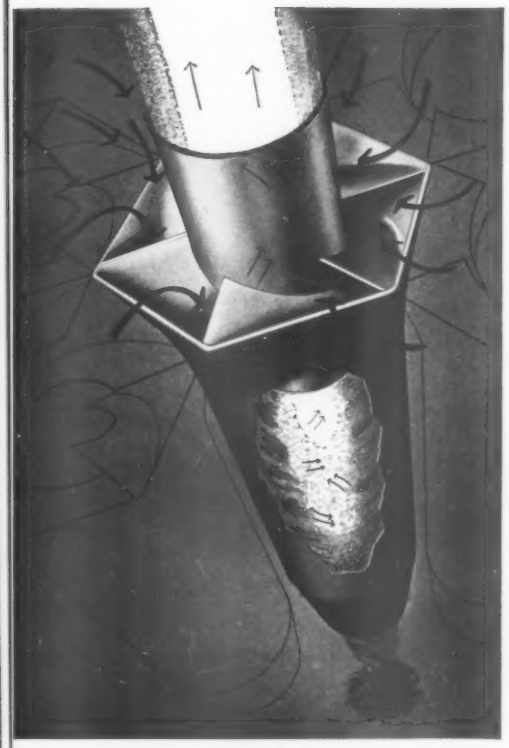

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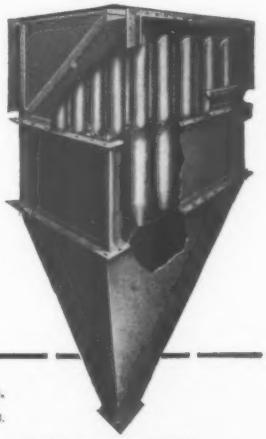

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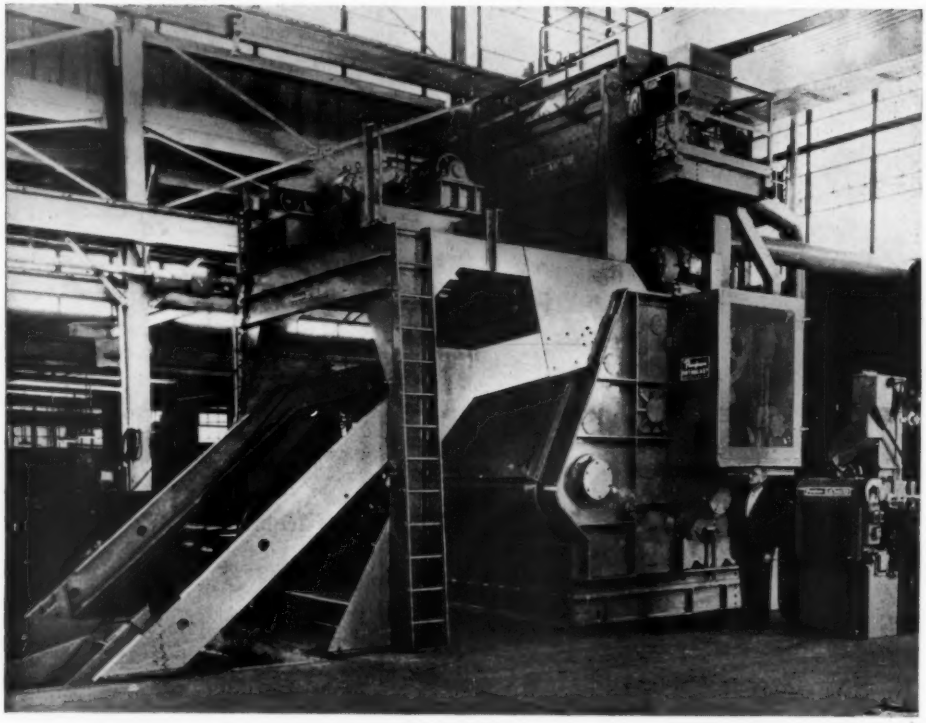

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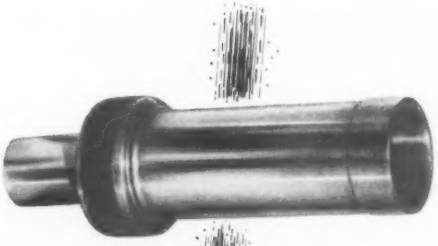

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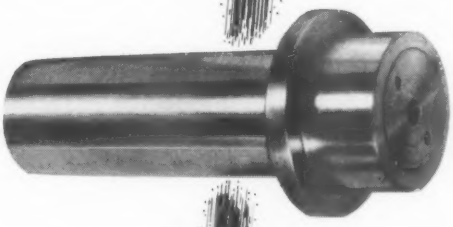

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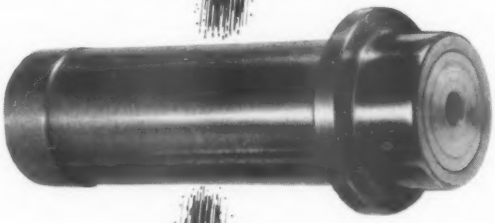

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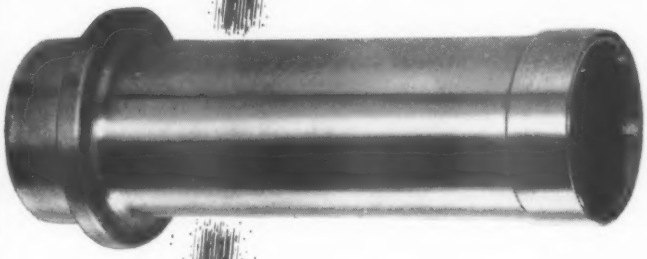

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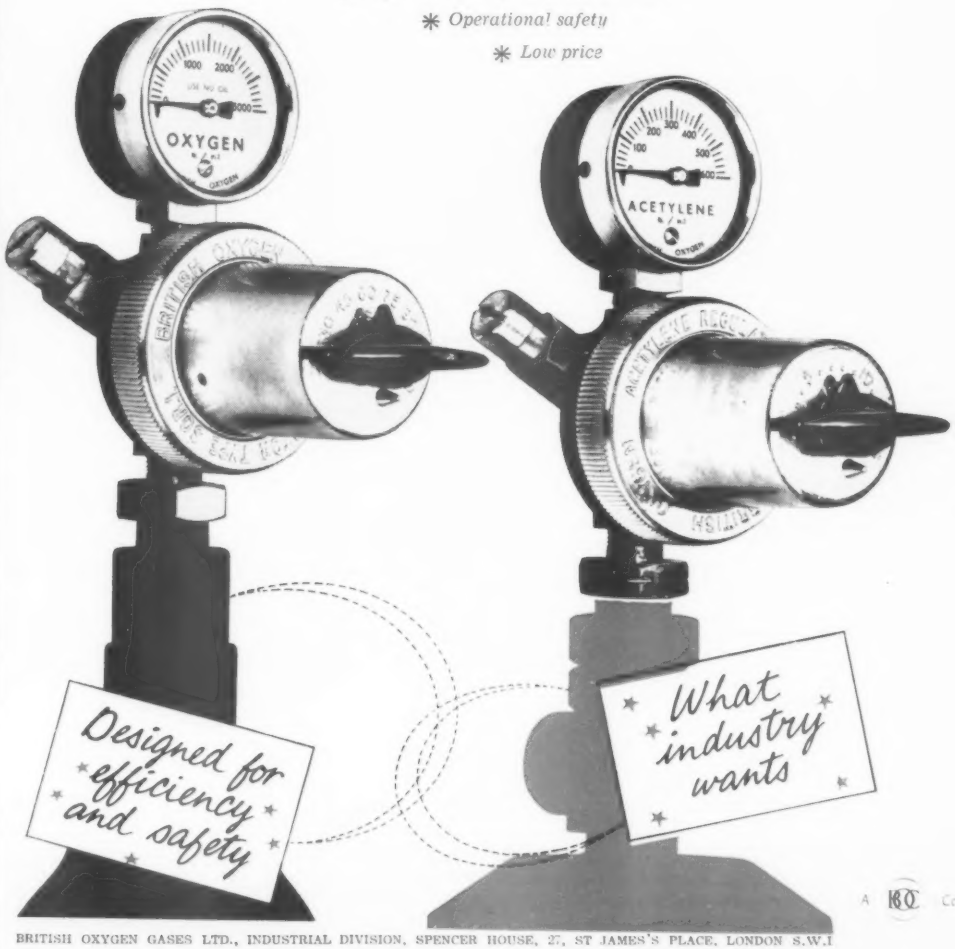

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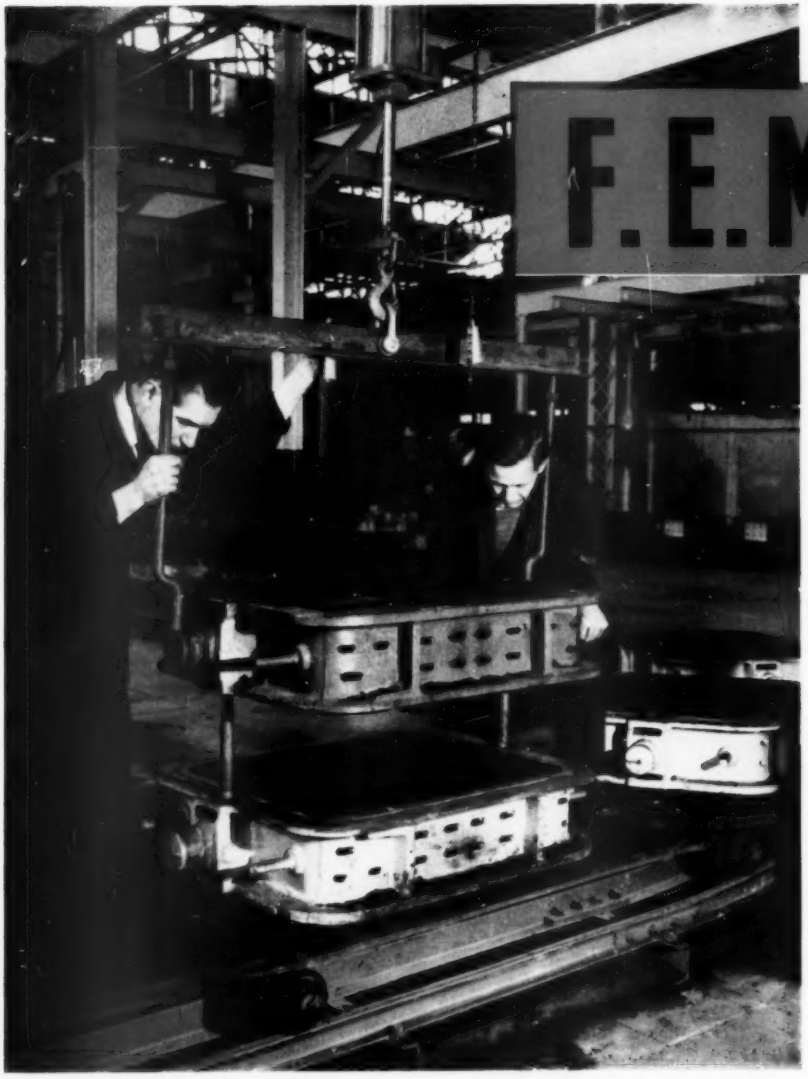

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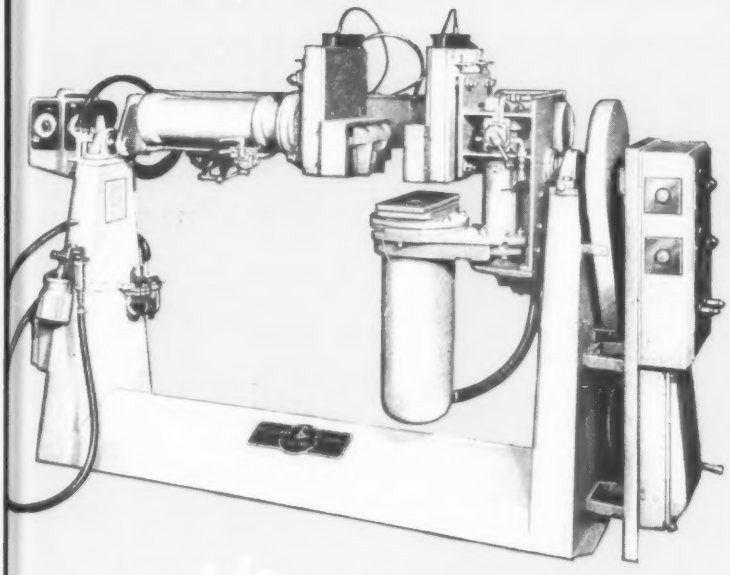
SHELL CORE BLOWER



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SHALCO Shell Core Blowers are rapidly ousting all other methods of Core production throughout the United States . . . and no wonder, for in addition to substantially reducing production and material costs, they also possess the following further advantages:

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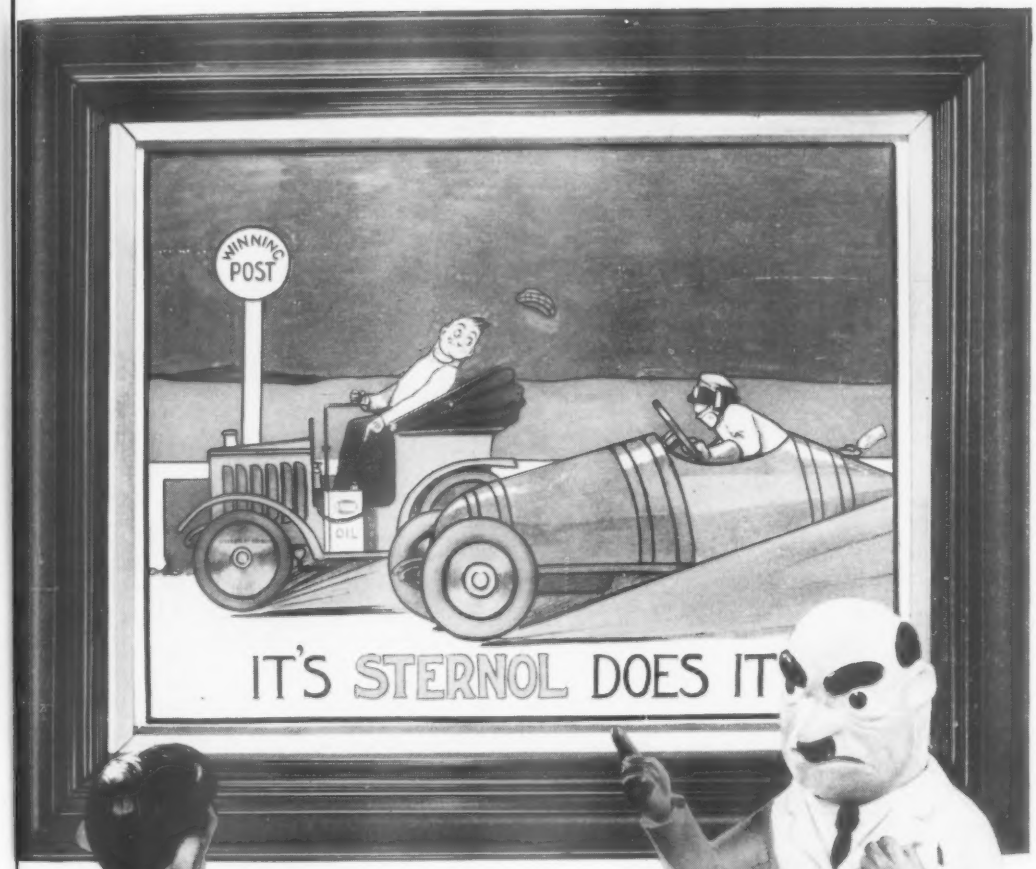

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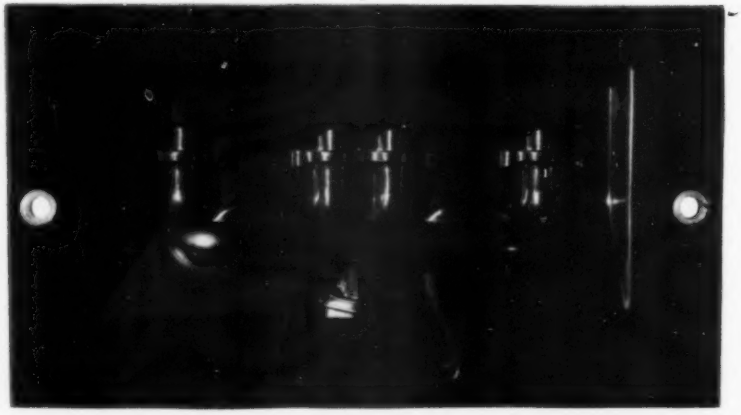
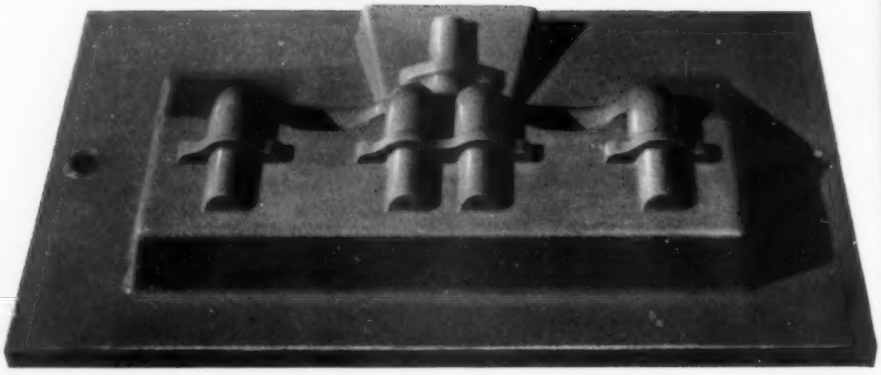


Foundry patterns cast in Araldite by H. J. Dowler (Engineers' Pattern Makers) Ltd., Birmingham



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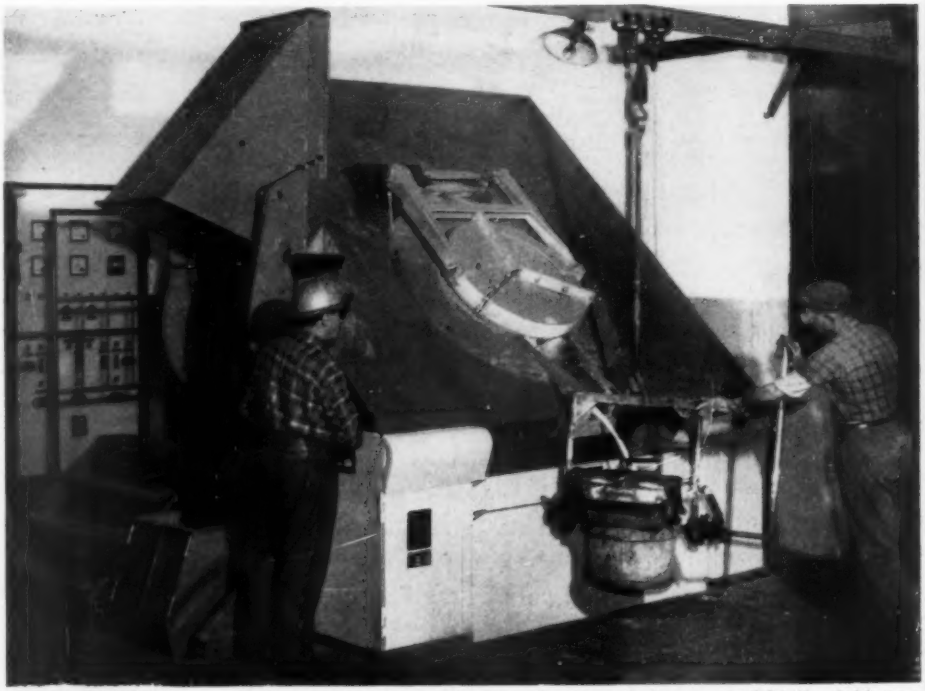

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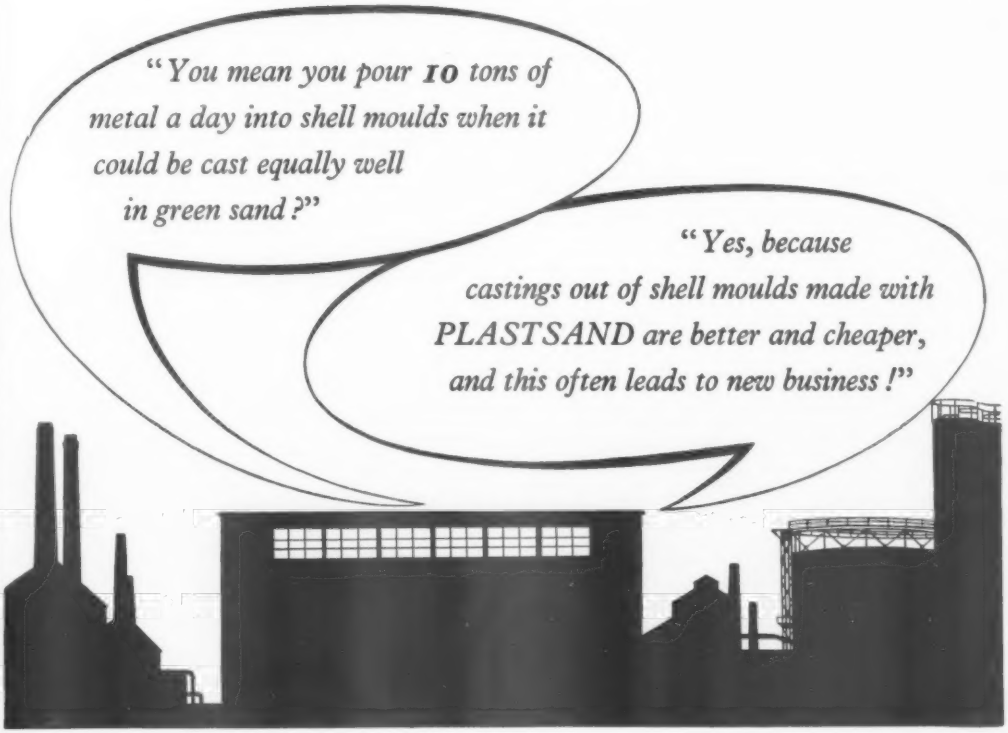
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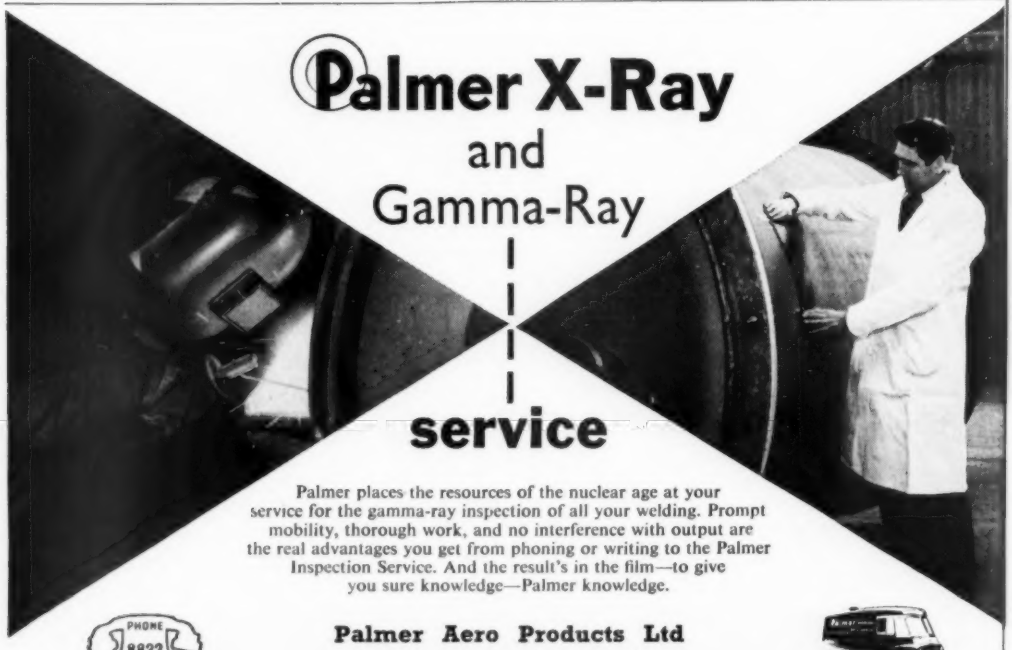

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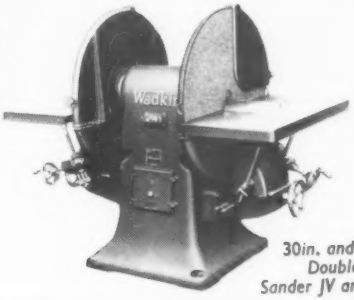

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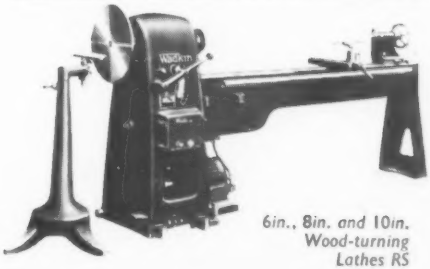

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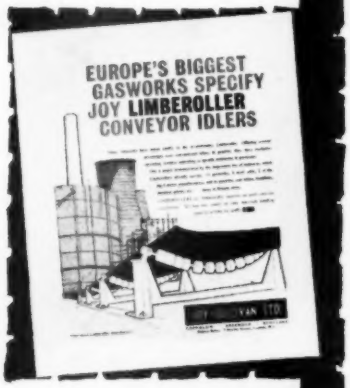

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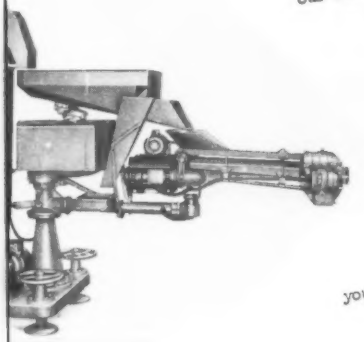

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1960

FOUNDRY TRADE JOURNAL

Vol. 108. January 7, 1960 No. 2248

Established 1902

Incorporating

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PRINCIPAL CONTENTS

PAGE

Mould Density and Mechanical Properties of Cast Alloys

By R. A. Jones and V. Kondic, B.Sc., Ph.D.

Account of experiments on various mould-ramming densities and their influence on macro- and micro-structure of the casting 3

Investment-casting of Precious Metals

By P. E. Gainsbury, A.I.M.

A comprehensive survey of the use of preciou-smetal investment castings in dentistry and jewellery production. Apart from their general interest, some of the little-publicized processes mentioned may be useful to the individual founder 11

La Densité des Moules et les Propriétés mecaniques des Alliages coulès. Par R. A. Jones and V. Kondic, B.Sc., Ph.D.
Compte-rendu sur des essays concernant le serrage des moules et l'influence de leurs densités variées sur la structure macroscopique et microscopique d'une piéce coulée. 3

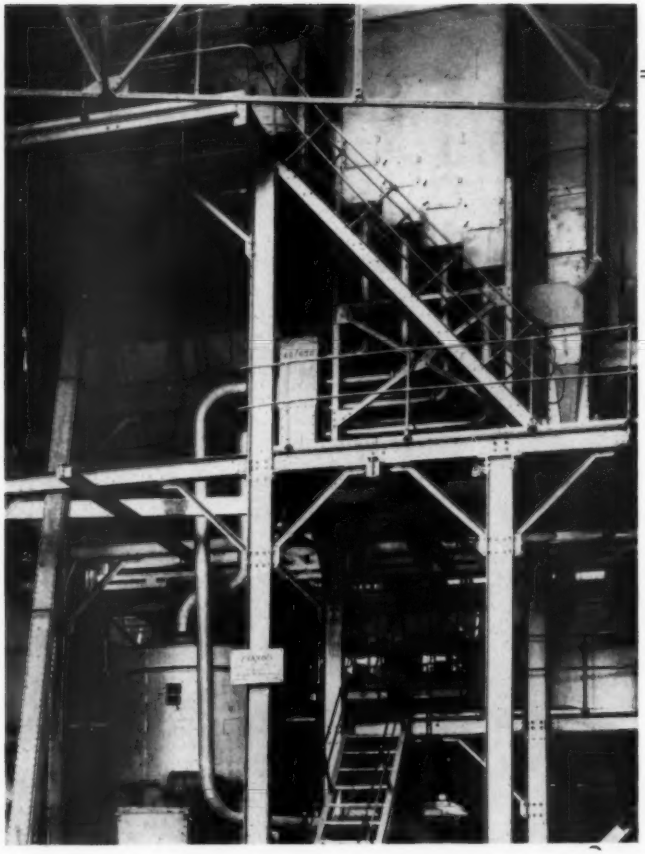
Coulées de Précision en Cire perdue de Métaux précieux. Par P. E. Gainsbury, A.I.M.
Étude précise de l'usage des coulées en cire perdue de métaux précieux pour la production de dentures et de joaillerie. Leur intérêt général mis à part, quelques uns des procédés mentionnés, qui sont peu connus, peuvent être utiles dans l'industrie des coulées à la cire perdue 11

Die Dichte der Gussformen und die mechanischen Eigenschaften gegossener Legierungen. Von R. A. Jones und V. Kondic, B.Sc.,Ph.D.
Bericht über Versuche zur Feststellung des Einflusses der Stampfdichte von Gussformen auf das makroskopische und mikroskopische Gefüge des Abgusses. 3

Genauguss in Edelmetallen. Von P. E. Gainsbury. A.I.M.
Eine ausführliche Ubersicht über die Verwendung von Edelmetallen für Genauguss in der Zahntechnik und in der Schmuckindustrie. Abgesehen von ihrem allgemeinen Interesse, dürften einige dieser wenig veröffentlichten Verfahren auch für den industriellen Feingiesser von Nutzen sein 11

Features, News, Commercial Information and Statistics

Leader: 1959 in Retrospect	1
A Foundry Centenary	2
Forthcoming Events	2
Equipment and Supplies	8
Notes from the Branches	20
New Year Honours	21
Golden Jubilees	24
Personal	25
News in Brief	26
Raw Material Markets	28
Current Prices of Iron, Steel and Non-ferrous Metals	30
Company News	32
Firth Cleveland to acquire Solartron Group	32
Machine-tool Orders	32
Pig-iron and Steel Production	34



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FOUNDRY
TRADE JOURNAL

Vol. 108 JANUARY 7, 1960 No. 2248

1959 in Retrospect

The year 1959 was characterized by a crescendo in trading conditions for the foundry industry taken as a whole, despite some black spots—notably in Scotland and the North-East Coast. Statistics issued towards the end of the year showed that both output and employment were improving, and in some areas—the Midlands for example—almost boom conditions are currently being experienced, the unemployed population having been reduced to less than one per cent. Sheffield, too, reports excellent trading conditions. In short, the trade pick-up has reached the machine-tool trade and only business for providing new capital—equipment requires a filip to give a balanced picture.

An outstanding event of the past year was the very successful foundry-equipment exhibition held at Birmingham during the Spring. It proved beyond doubt that a good, well-timed specialized exhibition needs no supporting programme—neither technical lectures, works visits, nor social events—to ensure success. In plain English, such trimmings mutually diminish attendances at the various functions, overcrowd the exhibition for short periods or empty it for longer ones. The International Congress in Madrid also was an outstanding success; here stress was laid on the social side and in showing the delegates the present state of the Spanish foundry industry and its ambitious programme of development, backed by intelligently-planned fundamental yet urgently-needed research.

As in other recent years, 1959 was characterized by the closing down of quite a large number of foundries, yet it is comforting to realize that the output from one new automobile foundry will often neutralize the loss brought about through several such closures. We have no criticism to level on the creation of large financial combines in industries, but we do deprecate the policy of the gradual elimination of the names of constituent companies, the value of which is frequently both nationally and internationally recognized. We deem that in the long run, much goodwill will be lost. Good trading-conditions as well as bad bring their problems, and we counsel foundry executives to take the opportunity of modernizing their plants, as this is the best insurance for reinforcing a firm's competitive potential if conditions deteriorate.

A Foundry Centenary

Pratchitt Brothers, Limited, Denton Iron Works, Carlisle, this year celebrate the centenary of their foundation, and a souvenir brochure has been issued to commemorate the occasion. The founder of the company was William Pratchitt, and the company came into being a few years after the holding of the Great Exhibition, which gave such an impetus to engineering. The original partnership was between Mr. Pratchitt and Mr. John Blaylock, the famous clockmaker. As would be expected, their original line of business was the making of steam engines, but later, much work was carried out for the rapidly-expanding railways. An interesting sideline was the supply of clocks for all the stations between Carlisle and Wigan. The usual pattern of development was followed, for during the first world war the works went on to shell making. The firm's post-war development saw the inauguration of the manufacture of timber-impregnating and preservation plant—a field in which a world-wide reputation has been gained.

The brochure carries illustrations of several installations of these plants, together with others showing the general nature of the various productions. The last few pages are devoted to the firm's social activities, but there is no figure given as to the present level of employment, though the brochure carries a picture of 22 apprentices taken on the occasion of a works visit, so one would envisage a personnel roll of about 300. Not much is said about the foundry department, but it is evident that it has made a considerable contribution to the progress made by the firm.

Contents of First-aid Boxes

New Regulations for the contents of first-aid boxes in factories, at docks, or on building sites, came into operation on January 1. These changes have been made in the light of advances made in medical and first-aid treatment of injuries during the last quarter of a century. Three scales of equipment are prescribed, one for establishments employing up to 10 workers, another for those where from 11 to 50 workers are employed and the third for those employing more than 50 workers. The same range of equipment has to be included in each box, but the minimum quantities are varied according to the number of employees. All materials have to be of a grade and quality not lower than the standard specified by the British Pharmaceutical Codex, and specifications for adhesive dressings for wounds and for eye ointment, for which the Regulations provide, are given in certificates of approval of the Chief Inspector of Factories.

Research Scholarship

A research scholarship in the use of light alloys in structural engineering is offered every third year by the Institution of Structural Engineers in collaboration with the Aluminium Development Association, the duration of the scholarship being two years and the value £600 per annum. The next award will be made this year to date from October 1. Details and application forms are obtainable from the secretary of the Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1. Completed application forms should be sent in to reach the secretary by March 31.

Forthcoming Events

JANUARY 11

Institute of British Foundrymen

Sheffield Branch : "Foundry Coke—Desirable Properties," by J. P. Graham, 7 p.m., at the College of Commerce and Technology, Pond Street. (Joint meeting with the Yorkshire section of the Institute of Fuel.)

Lancashire branch : "Gunmetal Castings—Specify the Best," by F. Hudson, 7 p.m., at the Midland Hotel, Manchester.

Association of Bronze & Brass Founders

Lancashire & Cheshire area: Meeting to be held at the Midland Hotel, Manchester, 5.30 to 7 p.m. (details from secretaries).

JANUARY 12

Institute of British Foundrymen

Coventry and district section: "Design and Manufacture of Metal Pattern Equipment for a Large Automobile Casting," by R. Cutler, 7.30 p.m., at the Coventry Technical College, Room A5.

Institute of Vitreous Enamellers

Scottish section: Annual dinner (details from secretary).

JANUARY 13

Institution of Plant Engineers

Dundee branch : "Surveying Electrical Equipment to comply with the Factories Act," by J. Townsley, 7.30 p.m., at the Taypark Hotel, West Ferry.

Western branch: "Safety in Factories," 7.15 p.m., at the Royal Society for the Prevention of Accidents, 1a, Queen's Square Avenue, Bristol

Institution of Production Engineers

Wolverhampton section: "Return of Quality as a Production Responsibility," by R. K. Grunau, 7.15 p.m., at the Star and Garter Hotel, Victoria Street, Wolverhampton.

Swansea section: Forum on "Craft and Technical Training of Apprentices to Meet the Modern Industrial Trend," 7 p.m., at the Central Library, Swansea.

Institute of British Foundrymen

Southampton section: Technical film show: "The Foundryman's Raw Materials," (production of coke and pig-iron) 7.30 p.m., at the Technical College, St. Mary's Street (liaison meeting with London branch).

Combustion Engineering Association

Northern region: Discussion on the "Workings of the Clean Air Act," 2.30 p.m., at the Royal Station Hotel, Hull.

JANUARY 14

Institute of British Foundrymen

Beds & Herts section: "Properties of Copper-base Alloy Castings," by F. Hudson, F.I.M., 7.30 p.m., at the Town Hall, Luton.

Institution of Plant Engineers

Glasgow branch: "Selection of Heating Systems for Factories and Offices," by T. Turner, 7.15 p.m., at the Scottish Building Centre, 425/427, Sauchiehall Street.

JANUARY 15

Institution of Production Engineers

Ipswich & Colchester section: "Contribution of Epoxide Tooling to Engineering," by E. M. White, 7.30 p.m., at the Golden Lion Hotel, Cornhill, Ipswich.

Latest Foundry Statistics

Light-alloy Castings. The Ministry of Aviation states that during September the production of aluminium-alloy castings from sand moulds was 1,799 tons; as gravity-die, 4,561 tons and as pressure-die-castings, 2,505 tons. In general these figures are higher than the year's monthly averages. The production of magnesium-alloy castings in September was 173 tons.

Ironfounding: The Council of Ironfoundry Associations states that the following numbers were employed in the United Kingdom during the week ending October 31:—Males, 116,952; females, 8,649; total, 125,601, representing an increase of 651 over the October 3 census.

Mould Density and Mechanical Properties of Cast Alloys

By R. A. Jones and V. Kondic, B.Sc., Ph.D.

The Authors first refer to mould ramming-density as one of the practical foundryman's "degrees of freedom" which he has used with the know-how gained by experience without really realizing implications, possibilities or limitations. In recording their experiments on one phase of this topic—in relation to mechanical properties of castings—they begin by stating the parameters, then refer to previous work and continue, logically, with an account of their experiments and results secured. Comment on these results is related to types of macro- and micro-structures obtained, and to the formation of "holes" in the castings.

One of the major characteristics of metal founding is the variety of mould types, and a very wide range of specific problems entering into making of different moulds. This makes it difficult to analyze moulding problems on a general quantitative basis and explains why progress in this direction has been slow. On the other hand, some specific moulding examples can be taken out to illustrate the nature of such problems rather than to account for them on a fully numerical basis. Mould density (or sand ramming-density) is a good case in point. This is a moulding property which could be described as one of the foundryman's "degrees of freedom" which he could vary in order to produce the most satisfactory casting or castings in any particular instance. In many instances, a foundryman bases his use of this freedom on the "know-how" gained by experience. In other instances, qualitative—or, much less frequently, quantitative—information exists which can be used to select most appropriate ramming-density or to predict the properties of castings in consequence of a selected ramming-density.

GENERAL

In general, sand ramming-density may effect some or all of the following:—

(*a*) Mould permeability and, through this, various metal/gas phenomena encountered in moulding (various types of "blowing," and metal/gas reaction).

(*b*) Mould expansion behaviour during pouring and various phenomena related to such an expansion (various surface defects, dimensional features, and internal properties of castings).

(*c*) Mould cooling or chilling power, and properties of the castings related to this (soundness, mechanical properties, distortion, and stresses).

(*d*) Mould strength, and through this different mould and casting properties (surface and dimensional features, sand adhesion and casting stresses).

The range of properties outlined earlier is sufficient (though not complete) to show the nature and complexity of the problem when an attempt is made to single out just one mould property such as ramming-density and then an endeavour is made to formulate exact relations of this property to any given property of a casting. In this report some brief experiments will be described which were designed to establish some relationship between the ramming-density and the mechanical properties of a simple-shaped casting produced in sand moulds. It was hoped in this way to add one more piece of information which would enable foundrymen to use the possible effects of ramming-density in any desired manner. Whilst it is appreciated that the choice of ramming-density frequently rests on other production considerations than that of mechanical properties of the casting, it is still maintained by the Authors that at least some instances are encountered in foundry practice where ramming-density could be freely adjusted to obtain a specific objective in the wide range of properties of castings which are desirable.

* Of the Authors, Dr. Kondic is senior lecturer in founding of the department of industrial metallurgy, Birmingham University (and president of the Birmingham branch of the IBF), and Mr. Jones is senior foundry technician of the department.

Previous Work

The effect of sand ramming-density on the mechanical properties of castings is not a problem which has received a great amount of attention in the past. If one considers molten metal contained in a sand mould-cavity then there are three possible ways whereby the mould could affect the properties of castings solidifying in the mould.

(*a*) First, the mould could expand under the effect of heat thus changing the overall size of the mould cavity. This problem has been studied by Gittus[1] and other workers at British Cast Iron Research Association, and is frequently referred to as the mould rigidity phenomenon. Briefly, it has been found that mould rigidity (which is amongst other things related to the ramming-density) may lead to either an increase in size of the mould cavity and thus enhance the shrinkage difficulties in the casting, or on the other hand produce what is effectively a decrease in the mould cavity during solidification —thus diminishing the shrinkage danger. The research workers mentioned were mainly concerned with the shrinkage behaviour of the casting in various types of grey irons.

Mould Density and Alloy Properties

(*b*) Secondly, the mould ramming-density may alter the chilling power of the mould, and through this it could affect the mechanical properties of the casting. One aspect of this problem was recently reported by T.S. 46 sub-committee of the Institute of British Foundrymen[2]. Various types of moulding materials and a range of types of moulding sands were used in conjunction with some typical grey irons. The properties of some simple-shaped castings, most of which were less than 1.5 in. in thickness, revealed that mould ramming-density can affect the mechanical properties of these irons up to the order of 10 per cent.

(*c*) Thirdly, it has been reported by several investigators that certain alloys have a tendency to expand during freezing[3]. Such an expansion would then be opposed by mould rigidity (controlled by mould ramming-density) and the net outcome of these forces may show itself in the mechanical properties of castings. Most of the work in this range has been concerned with the metal expansion behaviour and no data have been reported on the resultant properties of castings.

It appears from this brief review of the previous work that a simple relationship between mould ramming-density and mechanical properties of castings in general cannot be expected. It is also clear that one of the fields requiring further research is that of relating the mould ramming-density to the properties of cast alloys ranging from aluminium to steel. The objective of the present work was that of providing some of this data.

TABLE 1.—*Mould Condition related to Mechanical Properties of the Casting Produced from it.*

Alloy.	Sand.	Mould.	Tensile strength, tons per sq. in.	Elongation, per cent.	Remarks.
Aluminium LM4 (Cu 2.2 and Si 5.06 per cent.)	Kingscliff	Cement	9.32		
		CO_2	9.68		
		Hard	9.44		
		Soft	8.96		
	Congleton	Cement	9.76		See micro, Fig. 1; density 2.76.
		CO_2	9.24		
		Hard	9.24		
		Soft	8.76		See micro. Fig. 2; density 2.75.
Aluminium LM6 (Si 12 per cent.)	Congleton	Cement	10.72	9	
		Hard	10.24	8	
		Soft	9.64	8	See macro. Fig. 3 and micro. Fig. 4.
Gunmetal, 85/5/5/5 (Zn 4.8, Pb 5.0 and Sn 4.9 per cent.)	Kingscliff	Cement	14.88	26	
		CO_2	14.20	23	
		Hard	15.00	28	
		Soft	13.8	23	
Gunmetal, 85/5/5/5 (Zn 4.8, Pb 5.0 and Sn 4.9 per cent.)	Congleton	Cement	15.6	32	
		CO_2	16.2	39	See macro. Fig. 5.
		Hard	15.0	29	
		Soft	13.8	27	See macro. Fig. 6 and micro. Fig. 7.
Spheroidal-graphite iron (annealed) (C 4.12 and Si 1.5 per cent.)	Congleton	Cement	27.88	7	
		CO_2	26.4	10.5	
		Hard	25.2	8.5	
		Soft	25.2	9.5	
Mild steel (standard heat-treated) (C 0.3 per cent.)	Congleton	Cement	30.0	11	
		CO_2	29.0	8	
		Hard	30.32	13	
		Soft	29.28	9	

EXPERIMENTAL WORK

(*a*) *Selection of Sands and Moulds*

The basic sand used in this work was Congleton; with two alloys, shown in Table 1, Kingscliff fine sand was used. Four different moulds of varying mould-density were used with these sands: *i.e.*, sands formulated with (1) 10 per cent. cement bond, (2) 5 per cent. water-glass—CO_2 bonded, (3) 3.5 per cent. bentonite and 3.5 per cent. H_2O, rammed very hard (density 1.6 gm. per cc.) and (4) the same as number (3) but rammed very soft (density 1.38 gm. per cc.).

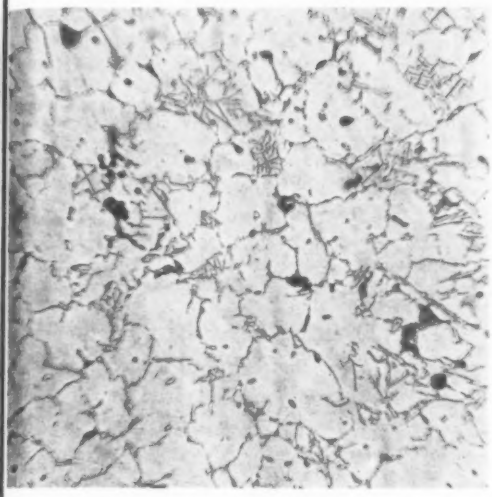

FIG. 1.—*Microporosity obtained in a hard-rammed mould with LM 4 aluminium alloy,* × 50.

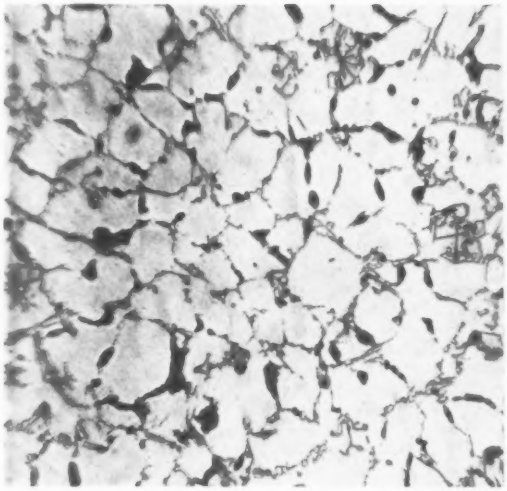

FIG. 2.—*Microporosity obtained in a soft-rammed mould with LM 4 aluminium alloy,* × 50.

(*b*) *Pattern*

A flat, 1 by 2 by 8-in., pattern was chosen for the work, partly because of its simplicity and partly because a fair amount of work in other similar research fields has been carried out in relation to this pattern and the results are already available. The method of moulding and gating was identical for all cases. From the downgate, through the ingate, the metal ran into the feeder situated at the end of the horizontally-moulded bar, lying on its wider side. The feeder was 2-in. dia. and 3-in. high, made in a sleeve of mouldable exothermic mixture. Some previous work had shown that the feeding technique adopted would be satisfactory to provide sound castings for all alloys used.

Consequently, any differences in properties of castings obtained from the four moulds could be attributed to the specific mould-properties rather than to inadequate feeding.

(*c*) *Alloys*

The most interesting metallurgical division of casting alloys is that of long- and short-freezing-range grouping. It is a generally accepted foundry experience that the short-freezing-range alloys are prone to less casting difficulties. Consequently, the alloys chosen for this work were essentially those having long freezing range, shown in Table 1. For comparison, however, one short-freezing-range alloy was also used, namely, Al/Si eutectic (modified).

Mechanical Testing and other Examinations

Each cast bar was cut longitudinally and one half machined into a standard tensile-bar, whilst the other half was used for metallographic study and density examination.

Experimental Results

The results of mechanical testing are shown in Table 1. Cross-sectioning and etching the other half of the bar showed any macroporosity, if present, and micro-examination revealed the presence of any microporosity. Macroporosity was revealed in gunmetal (85/5/5/5) alloy and steel bars only, showing that further improvement in feeding was required in these two cases. Some microporosity was revealed in all alloys. The extent of such microporosity had a direct relation to the mechanical properties, as shown in Fig. 1 and 2, for aluminium, LM4 alloy. This was confirmed by density measurement. Such a relation between the extent of microporosity and mechanical properties was confirmed with all other alloys, so that density measurements were discontinued. In the case of aluminium, LM6 alloy, on the other hand, a definite coarsening at the grain boundaries was the main difference between samples with the best and worst mechanical-test results. The micro-examination of spheroidal-graphite iron did not show any differences in the structure of various samples. (It was shown on the other hand that the annealing time used was on the short side, and this explained the low elongation-values.) Similarly, mild-steel samples revealed no differences in microscopic examination.

Comments on Results

One statement could be made which appears fully justified on the bases of the results obtained. This is, that the sand ramming-density bears a definite relation to the mechanical properties of alloys and castings used. How far this statement is general only further work will show, but the

Mould Density and Alloy Properties

results obtained certainly warrant a more detailed study of the problem.

Basis for Future Work

In order to provide a basis for such future work as well as to explain present results, the problem will be briefly analysed and commented upon:—

If a hypothetical casting, solidified in a sand mould, be taken, then its mechanical properties will be an overall summation of the effects of a number of factors. These factors can be conveniently divided into two main groups, those of structure and those of soundness, and these could be examined on a macro- and micro-scale in either case. In the structure field, there are mainly the problems of crystals or grains and heterogeneity, and in the case of soundness, the size, shape and distribution of holes.

It is interesting next to examine those structural and soundness factors which have a detrimental effect on the mechanical properties of a casting, and then to discuss how far mould ramming-density can effect these factors.

In the field of "grain-structure of a casting," there are so many variables that only two major ones will be discussed here; these have played a part in the results set out in this report. As seen in Figs. 3, 5 and 6, the size of macrograins may not be detrimental to mechanical properties of some alloys, but every alloy has to be considered on its own merits. The finer-size grains within these large grains (or so-called secondary constituents) may play a more-important part than macrograins. In the great majority of alloys, it is beneficial to have these small grains as fine and as evenly dispersed as possible.

On the subject of "holes" in a casting, there is no exception, as far as mechanical properties of a casting are concerned: the holes are always detrimental, the question is only that some are more so than others.

With this brief resumé of structure and soundness effects on the mechanical properties of a casting, the problem of mould ramming-density and its influence on mechanical properties of a casting can be examined.

The work of T.S. 45 sub-committee of the Institute of British Foundrymen has shown that an increased sand ramming-density raises the chilling power of the mould. It is thus possible that

FIG. 3.—*Macrograins obtained in both hard- and soft-rammed moulds in LM 6 alloy,* × 5.

FIG. 4.—*Microstructure of LM 6 alloy produced in a soft-rammed mould,* × 150.

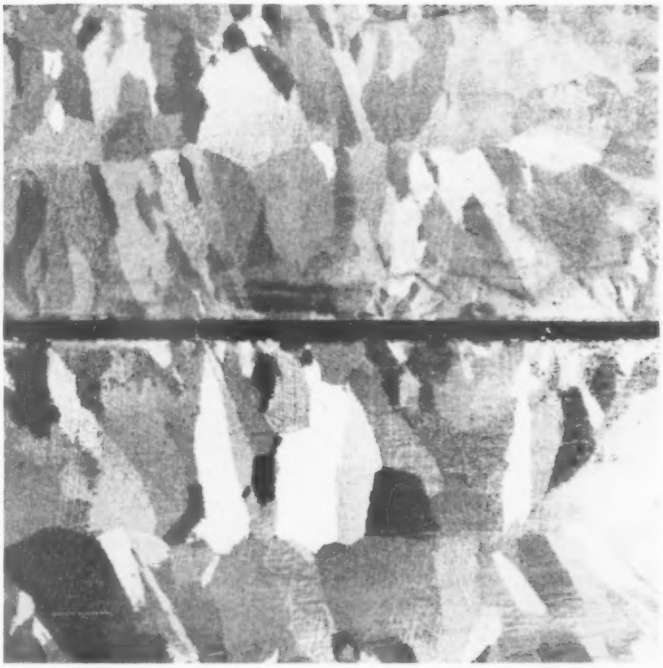

FIG. 5 (*top*) *and* FIG. 6 (*bottom*) *—Macrostructure of* 85/5/5/5 *gunmetal, respectively, in a hard-rammed and a soft-rammed mould;* × 1.

with the faster cooling rates two possible effects may be produced. First, the grain-structure may be improved, be it on the macro- or micro-scale, and secondly, more-favourable temperature gradients during solidification may be obtained, thus leading to better feeding and sounder castings. It appears that the macrograin is little effected by the sand ramming-density, as shown in Figs. 5 and 6, but that the secondary constituents may be more affected. This was shown to be the case with grey iron, where graphite flakes size was reduced, as well as with Al/Si eutectic alloy, where coarsening of Si particles at the grain boundaries occurred with slower cooling rates (*i.e.*, soft ramming) as shown in Fig. 4.

There appears little doubt that in the present work the mould ramming-density produced larger effects on the soundness than on the structure. This is shown with most alloys, for example by comparing the soundness of alloy LM4 produced in hard moulds, Fig. 1, with that of the same alloy produced in soft moulds, Fig. 2. The same was true of leaded bronze, where ramming produced typical grain-boundary type of porosity in soft-rammed moulds, Fig. 7. This type of porosity was not present in castings made in hard-rammed moulds in the same alloy.

It is difficult to explain at the present time whether the decreased soundness of castings produced in soft-rammed moulds is due to the lower chilling power or different expansion during solidification (mould rigidity) in comparison with hard-rammed moulds. This is an important point for further future study.

CONCLUSION

It has been shown that mould ramming-density, apart from all its known and established effects on the properties of castings, may also exercise a major influence on mechanical properties of many cast alloys. It is hoped that the publication of these preliminary results will encourage a wider study of this important foundry problem.

Acknowledgments

The Authors wish to acknowledge their indebtedness to Professor E. C. Rollason (Birmingham University) for provision of laboratory facilities, and encouragement in foundry research.

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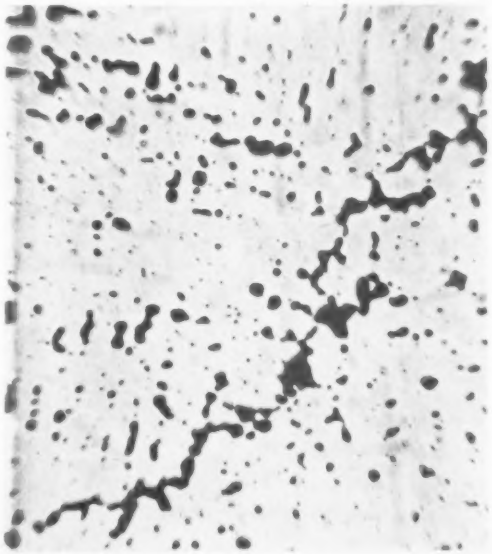
[2] Sec. Rep. of Sub-com. T.S.46, *Br. Foundryman*, 1959, **52**, 66.
[3] W. B. Hendry and S. N. Wrighton, *Br. Foundryman*, 1958, **51**, 82.

FIG. 7.—*Microporosity obtained in gunmetal* 85/5/5/5 *alloy in a soft-rammed mould,* × 50.



Equipment and Supplies

Mould Dryer (Electric)

Efco, Limited, Netherby, Queens Road, Weybridge, Surrey, announce that, by an agreement with Brown Boveri & Company, Limited, of Switzerland, their subsidiary the Electric Resistance Furnace Company, Limited, are to make portable electric mould-dryers (Fig. 1) of the Swiss firm's design. When used for drying floor moulds and large box moulds these operate by forcing hot air not merely over the mould surface but through the sand itself, and for this reason it is claimed that more efficient drying is achieved. Using air temperatures some 100 deg. to 150 deg. C. lower than usual, and less than one third the quantity of heat, it is stated the electric dryers have reduced drying times by a half and in some cases by two thirds. The heating is uniform throughout the mould and despite the rapid drying, mould surfaces remain free from cracks and cleaner castings are produced. Other claims are that the dryers need no attention during operation, the power input being regulated automatically to maintain the desired air temperature; working conditions are improved by the elimination of smoke and burning gas. Large cores can be inserted in the moulds and dried at the same time, the castings then being poured without re-opening the moulds. The drying equipment consists of an electric air-heater, a fan and enclosed driving-motor, and control gear, all of which is assembled into a single unit. Amongst other control features, a manometer is incorporated to measure the static pressure in the mould, and indicate the density of the mould and the porosity of the sand.

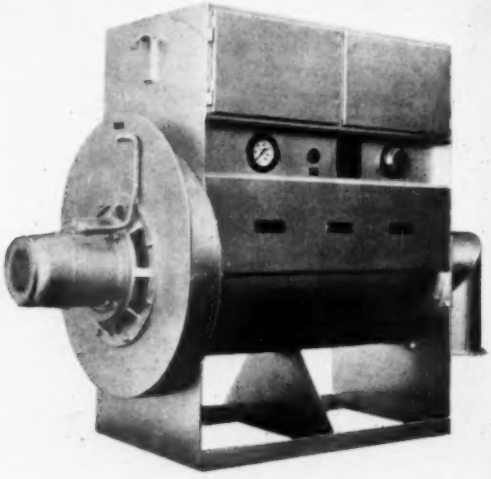
In use, a mould to be dried is covered as for casting and the dryer is placed in position over the ingate. All openings with the exception of the core and coke-bed vents are closed. With the dryer in operation, hot air is forced through the moulding sand, where it gives up its heat and passes out through the vents saturated with steam. The absence of issuing steam indicates that drying has been completed. This mould-drying stove is to be made in three ratings of 25-, 70-, and 140-kw., and in two temperature ranges, one for use in grey-iron and non-ferrous foundries, where temperatures up to 350 deg. C. are sufficient, the other providing temperatures up to 650 deg. C., for use in steel foundries.

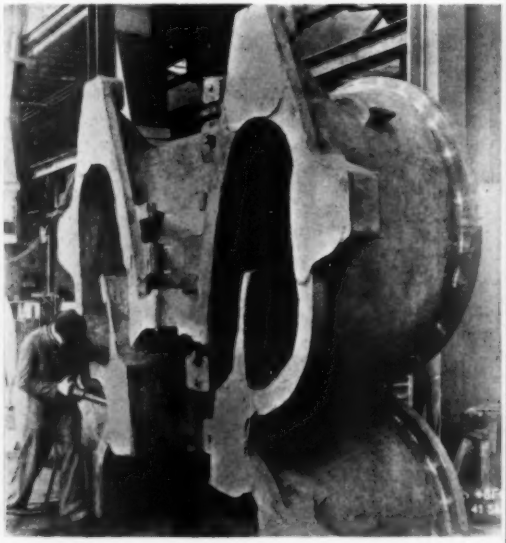
Lifting Magnets for Heavy Duty

The new heavy-duty lifting magnets now being manufactured by Industrial Magnets, Limited, 28, Station Road, Acocks Green, Birmingham, 27, have been specially designed for the rapid handling of all ferrous materials. They are constructed in high-permeability steel with a very-heavily-ribbed outer shell, toughened manganese-steel bumping-plate, and fully-protected terminal box. This new magnet is manufactured in five sizes ranging from 35 to 55-in. dia., the usual circular pattern being adopted, it is stated, due to its suitability for handling the great diversity of materials encountered in scrapyards, and its consequently greater "pay load." The magnet is also suited for use with portable cranes. Ancillary equipment—including magnet controllers, cable-reeling drums and rectifiers—can also be supplied to suit the magnets.

Shotblast Gun: Vacu-Blast, Limited, Wellcroft Road, Slough, Bucks, have introduced the Major Mark II, a mobile shotblast gun which operates on one small area at a time, simultaneously sucking back the dust and grit created, and separating them. So far, the unit has been used extensively only in steelworks, but is worth bearing in mind for certain types of fettling jobs in foundries.

FIG. 1—*(left) A 70-kw. portable electric mould-dryer, of the Brown Boveri type, to be manufactured in this country by the Electric Resistance Furnace Company, Limited; (right) the mould for this steel gas-turbine housing was dried ready for pouring in 10 hr. with a 140-kw. Brown Boveri mould-dryer. The mould had an overall surface area of 269 sq. ft.; the casting weighs 9 tons.*





"Waste" Heat in Foundries

Possible Schemes for Utilization carry a Challenge from Designers

The writer discussed with an engineer recently the considerable amounts of heat which are normally wasted in a variety of foundry operations—melting/cooling, heat-treatment, radiation from hot metal, etc. He was forced to the conclusion that although potential savings of heat are fairly obvious, there is little documentary evidence that any heat-conservation schemes have in fact been put into practice.

The general lack in industry of installations designed to conserve heat has brought forth a challenge from designers that, if founders could supply data as to the amounts of heat-loss at present experienced, schemes can be prepared which, at moderate capital outlay, will bring really substantial overall economies.

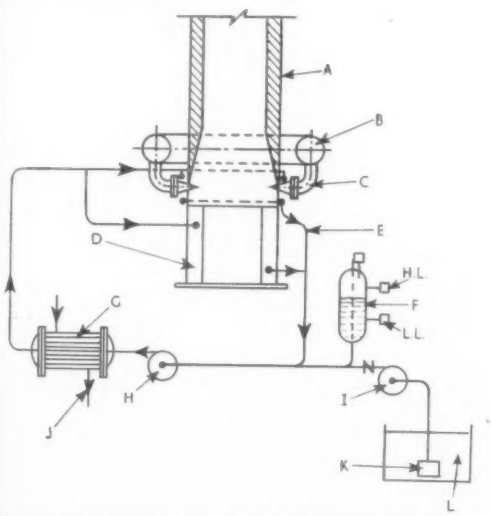


FIG. 1.—*Schematic layout of a design suggested for utilizing the sensible heat imparted to cooling water in a modern hot-blast cupola. A pressurized system, using only make-up water treated to prevent scaling or corrosion, is suggested.*

KEY: A—Hot-blast cupola (primary heat-exchanger); B—hot-blast windbelt; C—tuyeres; D—water-cooled cupola; E—closed water-circuit; F—pressure vessel; G—secondary heat-exchanger; H—circulating pump; I—pressure-feed pump; J—cooling medium used for other services (heating hot-water systems, etc.); K—filter, and L—make-up tank.

Potential Field

In production processes within the foundry industry, continuous attempts are being made to improve output or efficiency of a particular operation. There are, with reservations, obvious limits to such improvements and further savings must therefore be sought elsewhere—then if these savings can in turn improve the overall thermal efficiency of a heat-using process, so much the better.

What are the facts known from experience of the lower grades of heat-sources within the industry? Because of the comparatively low temperature-differential arising in waste gases, cooling-water, radiated air, etc., these heat sources cannot often be re-used economically in many instances directly in helping production. It does not mean to

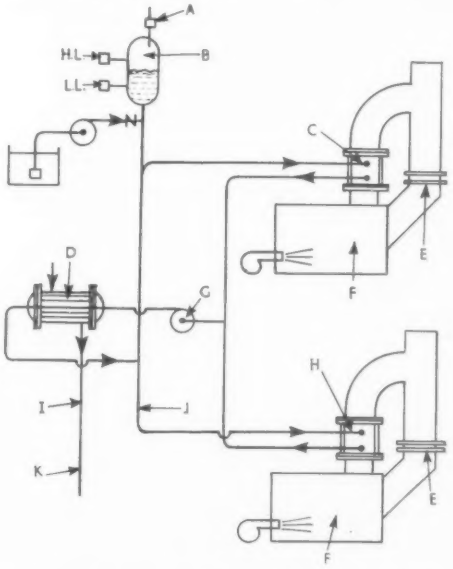


FIG. 2.—*A similar system to that shown in Fig. 1, but applied to the waste gases passing to the stacks in a battery of heat-treatment furnaces.*

KEY: A—Control switches; B—pressure vessel; C—primary heat-exchanger; D—secondary heat-exchanger; E—dampers; F—heat-treatment furnace; G—circulating pump; H—primary heat-exchanger; I—secondary circuit; J—primary circuit, and K—cooling medium for other services.

say, however, that these waste products cannot be used for subsidiary purposes, thereby saving money and hence reducing manufacturing costs.

Examples of Possible Heat-conservation

To take three concrete examples, the water-cooled cupola, the heat-treatment furnace, and the molten-metal receiver, sketches shown in Figs. 1 to 3 represent approaches which might be developed

if more data were available. The details obviously are variable, as are the particular types of heat-exchangers chosen.

It is interesting to note that the particular application shown in Fig. 1 might well make for improved control. For example, if the cupola cooling-water causes low temperatures in the cupola, it represents a poor heat-cycle; if the temperature of the cooling water is raised to that of steam generation, vaporization occurs, with consequent failure of the cupola wall or "coolers," due to excessive temperature build-up. If, on the other hand, by pressurization of the cooling water its temperature can be increased without its "flashing" into steam, satisfactory cooling to avoid damage to the cupola wall or the coolers might be achieved without extracting unnecessary heat from the melting process.

Challenge of Modern Times

There are almost innumerable cases in foundry and metallurgical processes where heat is wasted. In the past, such losses have been regarded as necessary evils of processing, fuel then being relatively cheap. There is no excuse for such complacency to-day when the necessary heat-exchanger plant is readily available—and relatively inexpensive—and fuel costs continue to mount.

It is one of the purposes of this article to try to awaken founders from present apathy in regard to these matters, and to issue a challenge for any one of them to come forward and explain what has been, or could be done to ameliorate the position.* If the writer were in a position to offer a prize for a successful scheme, he would do so—it is so irksome to see on one hand much *expensive* heat going to waste, while on the other hand founders are vying with one another in chopping farthings off the selling prices of their castings.

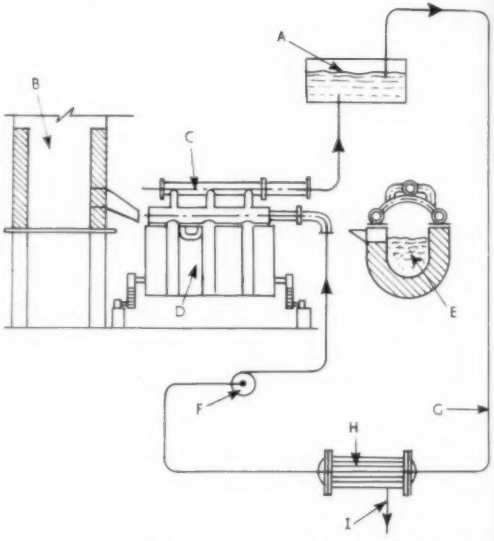


FIG. 3.—*Suggested layout for the application of a primary radiant heat-exchanger to a molten-metal receiver, as a means of utilizing—in the form of hot water—some of the heat that would otherwise be lost. Obviously, with but minor modification, similar systems could be applied to other radiant-heat sources in the foundry industry—pig casting, casting/cooling, ladle drying, etc.*

KEY: A—Pressure vessel; B—cupola; C—primary radiant heat-exchanger; D—tilting hot metal receiver; E—molten metal; F—circulating pump; G—primary circuit; H—secondary heat-exchanger (alternatively circulating load equivalent to heating load circulated continuously from the primary circuit), and I—secondary circuit.

* The Editor would welcome for publication correspondence on this subject, or accounts of where such heat-conservation has been proved successful, or even—to show the pitfalls to others—of cases where attempts have failed.

British Shipbuilding Prospects

Uncertain year for British shipbuilding in which the tonnage of existing contracts cancelled was outstripping that placed as new orders, has closed on a rather more cheerful note, states Col. T. Eustace Smith, president of the Shipbuilding Conference, in an end-of-the-year message on the state of the industry. The fact that a number of the important orders announced in December were for ships for overseas owners was an encouraging indication of British competitive strength.

Enterprise of UK shipbuilders in bringing their yards to a high state of efficiency had been demonstrated recently in some outstanding building times, but it should not be overlooked that the firms concerned had submitted keen prices to keep their yards in production and to maintain employment. Allied with genuine and farsighted co-operation on the part of labour, British shipbuilding could hold its ground in the face of intense international competition.

The industry entered 1960, Col. Smith states, with an order-book of more than 4,000,000 tons gross, but orders were not evenly distributed and there was still the possibility of more cancellations and deferments.

United Steel in India and Pakistan

Changes in the managements of its Indian and Pakistani companies are announced by the United Steel Companies, Limited. Mr. J. P. Jessop, manager of the United Steel Companies (Pakistan), Limited, has been appointed managing director in succession to Mr. L. L. Boyd, who is returning to this country to become deputy commercial manager of the Steel, Peech & Tozer branch of United Steel.

Mr. R. M. Marshall, who has spent several years with the United Steel Companies (India), Private, Limited, and who is at present completing a two-year course at the Harvard University Graduate School of Business Administration, will succeed Mr. Boyd as managing director of the Indian company. Mr. Marshall will not be available to take up this appointment until September/October, 1960, and in the interim period from mid-February, Mr. S. B. Wagh, a director and secretary of the Indian company, will be responsible for the duties connected with the post. Mr. S. Kumar will be in charge of sales in Bombay and Mr. G. Hill in Calcutta, both responsible to Mr. Wagh.

SECTION DEVOTED TO THE TECHNOLOGY OF PRODUCING DIMENSIONALLY-ACCURATE CASTINGS

Investment-casting of Precious Metals

*By P. E. Gainsbury, A.I.M.**

Although the precious metals are widely used for industrial and scientific purposes they are normally employed in the wrought condition, and castings are only used in the relatively self-contained and possibly, therefore, obscure fields of dentistry and jewellery production. The purpose of this paper is to describe some of the techniques and equipment used in these fields. It is hoped that some features of these little-publicized processes may prove to be interesting and possibly useful to those practising in the wider field of industrial investment-casting; in particular, the methods of dimensional control used in dental casting, and the rubber dies, investment materials and casting techniques used in jewellery casting.

The techniques used in dental and jewellery casting, though related, are rather different and it is best to consider the two processes separately. It should be added that, in dealing with dental casting, the casting of base-metal dental alloys will not be discussed. Most of the techniques used in the processing of the moulds for these alloys are the same as for precious metals, but the investment materials and melting techniques used are more akin to those used in the industrial casting of the same types of alloy, and do not fall within the scope of this paper.

DENTAL CASTING

Although the basic lost-wax process stems from the age-old casting processes of the sculptor, the technique of using a liquid investment slurry was originated in 1898 by an American dental surgeon named Philbrook[1], for casting dental inlays, and it is to Philbrook and his successors in the dental profession that the modern investment-casting industry owes its foundation.

Applications of Metal in Dentistry

Investment castings are used in a number of ways in dentistry, the most familiar being the construction of cast metal dentures, which are acknowledged to be superior to plastic dentures in any form, and to wrought dentures in any metal. Investment castings are also used as: supports for fused porcelain bridge-work; inlays and crowns for individual teeth; orthodontic appliances for correcting malformation of the dentition, and as temporary splints for the treatment of jaw injuries. The same basic processes are employed for all these applications, the only differences being found in the method of making the pattern, and the choice of alloy cast.

Alloys Selected

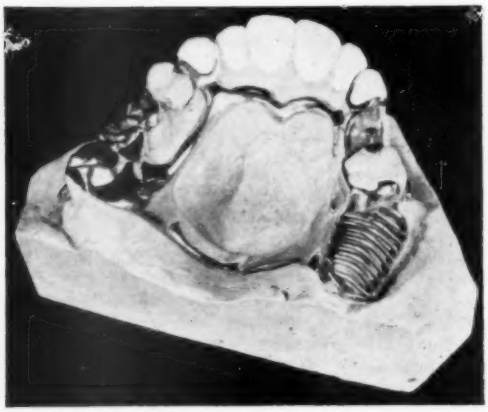
The precious-metal casting alloys used in dentistry fall into three main classes. These are: gold- and palladium-base alloys, used for inlays and dentures; silver alloys, used for temporary appliances, and platinum and other alloys used for supports for fused porcelain. The gold and palladium alloys are the most important group, and may be sub-divided into yellow and white alloys.

The yellow alloys are all gold-rich, and range from soft, 22-carat alloys used for inlays (which must be soft enough to permit burnishing of the edges of the casting, to seal the joint with the natural tooth structure) to complex heat-treatable alloys containing copper, silver, platinum, zinc and possibly minor amounts of other metals. These alloys have excellent ductility in the softened condition, but can be hardened to high tensile-strengths for the construction of delicate partial dentures.

The white alloys usually also contain some gold, but in addition up to 30 per cent. palladium, together with copper, silver, and sometimes a little platinum. These alloys are generally harder than the yellow alloys and, being cheaper and of lower density, are suitable for the construction of large appliances. The white alloys are also heat-treatable, and, by suitable solution-treatment followed by age-hardening, castings can be obtained with limits of proportionality in excess of 60 tons per sq. in. Temporary splints and orthodontic appliances are cast in silver hardened with a small percentage of copper. These alloys are liable to tarnish in prolonged use in the mouth, but in these applications aesthetic considerations are of minor importance.

Traditionally, the alloy 90-per cent. platinum, 10-per cent. irridium, was used for cast supports for fused porcelain work, but with the high cost of platinum this process has been much less employed in recent years. Currently, however, there is a revival of interest in fused porcelain, and much development work is in progress to produce new

* The author is research metallurgist at Mond Nickel Company, Limited, of London. This article is a slightly abridged version of a paper presented by Mr. Gainsbury at the sixth annual conference of the European Investment Casters' Association, held in Essen, Germany.



Casting for a skeleton partial denture.

alloys to replace platinum. A difficulty here is that base metals, the oxides of which tend to colour porcelain, cannot be tolerated, and current research seems to be centred around gold- and palladium-rich alloys with various hardening additions, but avoiding the use of copper, as in normal dental alloys.

Technicians' Problem

There are a number of factors confronting the dental technician, when he makes a casting, which combine to present him with a problem which is probably unique in any casting process. First, above everything, the finished casting must fit exactly in the position where it is to be worn. The technician works from an exact-size model of the mouth or tooth in question; consequently he can only make the pattern to the exact final size required in the casting, and so must produce a casting which is the same size as the pattern. There can be no allowance for casting shrinkage. Allied to this no distortion can be tolerated, and, as the thickness of the wax pattern may be only 0.020 in. or less, it must usually be retained on a rigid support at all times, and cannot be removed for complete investing.

Dental castings are frequently required at extremely short notice. If a patient is waiting to have a badly fractured jaw set there is no time for a second attempt in casting a splint. The finished appliance must be produced quickly from scratch, and it must fit. No two dental castings are exactly alike, and the sprueing technique has to be considered separately for every cast. The technician may even find that he has to design the appliance himself before making it. To offset these difficulties the technician has perhaps two advantages. First, he usually carries the whole job through every stage himself, and thus has personal control over every part of the process; second, each mould cast contains only one item, so that each casting can receive individual attention.

Patterns

The wax patterns for dental castings are always hand-made, though approximate pre-formed shapes may be adapted to the exact shape required and incorporated in the pattern. Except in the case of inlays the patterns are built up on a plaster model of the mouth, which is cast in a flexible impression taken by the dental surgeon. The pattern is built up from thin sheet-wax and deposits of molten wax, and is carefully formed to the exact contour of the model. Inlay patterns may be produced by shaping wax in the prepared cavity in the living tooth, or an electro-formed copper die may be made on a plaster impression of the tooth.

Sprues

Sprues are fitted to the pattern whilst it is mounted on the model. Techniques of sprueing are widely varied, and many would horrify the conventional foundryman accustomed to a generous array of gates and risers. The most common technique in the past has been to provide a multiplicity of long narrow sprues attached to convenient points on the pattern, often with a small reservoir in the sprue about an eighth of an inch from the pattern. Risers, as generally understood, are never used, though occasionally vents are provided. In recent years a tendency to use sounder sprueing techniques has become apparent, and a currently popular practice for partial dentures is to provide a heavy central feeder in the centre of the palate with short sprues running from this to the periphery of the pattern.

Investments

As stated earlier, a dental casting must be exactly the same size as the pattern. This is accomplished by using an investment which has an expansion at the moment of casting which is as near as possible equal to the casting and cooling contraction of the metal. Investments for casting gold and silver dental alloys are invariably based on mixtures of plaster of Paris, or hydrocal and some form of silica. The plaster content may be from 25 to 45 per cent., and up to 2 per cent. of minor additions may be made to control expansion and setting characteristics.

Setting Expansion

Three effects are combined to produce the necessary expansion of about 1.25 per cent. at the casting temperature to compensate for the shrinkage of the casting. These are setting expansion, hygroscopic expansion and thermal expansion. The setting expansion of a plaster investment is affected by: the powder/water ratio, the extent of spatulation during mixing, the temperature of the mixing water, the presence of addition agents, and whether hydrocal or plaster of Paris is used (the former giving a greater expansion). Although not directly contributing to the setting expansion, the silica content is also important, as the presence of silica permits greater growth of gypsum crystals during setting, giving greater expansion. Additions of sodium sulphate decrease the setting time and expansion, while additions of borax or sodium citrate increase setting time but decrease setting

expansion. The addition of ground gypsum reduces setting time but increases setting expansion. Thus, with the use of these agents a wide range of control is possible. The setting expansion of dental plaster investments is usually controlled between 0.1 to 0.45 per cent.

Hygroscopic Expansion

Hygroscopic expansion occurs when plaster is brought into contact with water during setting, and again the presence of silica facilitates this process. The hygroscopic expansion, though it may be as much as 2 per cent., is rather variable with different investments, and is generally only used in a specialized inlay-casting technique.

Thermal Expansion

The most important factor in obtaining sufficient expansion of the mould cavity is the thermal expansion on firing. Plaster of Paris on its own shows a considerable contraction on heating due to dehydration, amounting to 1.9 per cent. at 500 deg. C. The necessary thermal expansion of the investment must, therefore, be provided by the silica content, which must be sufficient also to counteract any contraction effect arising from the plaster. At the same time, however, the silica content must not be so high as to weaken the investment. Fortunately, the thermal contraction of the plaster can be modified or eliminated by the addition of small quantities of alkali-metal chlorides. The use of this effect permits a suitable balance to be obtained between the plaster and silica contents of the investment. The silica is employed in the form of quartz or crystobalite, and use is made of the large expansion occurring in these materials at the temperature of the inversion from alpha to beta form. With crystobalite, the inversion occurs at 210 to 260 deg. C., and gives a greater expansion than with quartz, where the inversion occurs at 500 to 600 deg. C. With crystobalite plaster investments sufficient expansion can be obtained to compensate for metal shrinkage at a temperature of 500 deg. C., and as little further expansion occurs above this temperature, the mould temperature to obtain an accurate casting is not too critical as long as it is above 500 deg. C. With quartz-containing investments, as the inversion occurs at the higher temperature, it is necessary to cast moulds at temperatures between 650 and 750 deg. C. to obtain adequate compensation for the shrinkage of the casting.

Dental Investment Techniques

Various investing techniques are used in dental casting practice, depending upon the nature of the pattern. Heavy or rigid patterns such as inlays and splints may be directly invested while supported on their sprue systems. In these cases the pattern may be enclosed in a small casting-ring, and investment in the form of slurry poured in and de-aerated by vibration or vacuum-treatment in the conventional fashion. Frequently, however, the investment, in the form of a thick slurry, is applied to the pattern by means of a small brush, air bubbles being eliminated by holding the pattern on a small vibrator while applying the investment. When the pattern has been completely enclosed in a mass of investment, it is fitted on a support by its sprue and enclosed in a ring which is then filled up with investment slurry.

Special Technique for Thin Patterns

Thin, delicate patterns cannot be treated by either of these procedures, as they would be distorted by the weight of the investment. In these cases either of two techniques may be adopted. In the first the model on which the pattern is constructed is itself made of investment material. When the model is complete with its sprues, the assembly is soaked in water and further investment slurry applied to cover the exposed wax. When the pattern is completely enclosed in investment, the assembly is fitted in a casting ring which is filled with investment as before. The wetting of the model ensures union of the new and old investment, and as the model becomes part of the final mould there is no possibility of distortion. In the other technique the pattern is laid down on a normal model. When it is complete the upper surface is covered with investment slurry, taking care not to fill any undercuts on the model. When this investment is set it is eased off the model, taking the pattern with it, and investing is completed as already described. In this procedure the model is kept dry so that it does not adhere to the investment.

For final investing, the pattern assembly is usually mounted on a simple metal or rubber cone which forms the base of the mould. Casting rings are usually plain mild-steel, and in the best practice are lined with wet asbestos-paper.

Firing of Moulds

Firing arrangements for dental moulds are usually very simple. A favourite device used in small laboratories consists of a split fireclay-lined sphere, with a large bunsen-type gas-burner at the

Wax pattern for a partial denture, showing the modern technique of sprueing through the palate of the model.

bottom and a short chimney on top. This serves for the firing of three or four dental-size moulds at a time. In larger establishments conventional gas or electric furnaces are used.

Melting of Dental Alloys

Almost all precious-metal dental alloys are still melted by gas torches. Most of the alloys cast have melting points below about 1,100 deg. C. and can be melted with simple air/coal-gas torches. The only exceptions are the platinum-rich alloys occasionally used for porcelain supports, which require oxy-coal-gas or oxy-acetylene melting torches. In recent years use has begun to be made of electric-melting techniques for dental casting. These techniques, however, are not yet widely used for precious-metal dental alloys, and as the same equipment is used in jewellery casting they will be discussed when dealing with jewellery casting techniques.

Melts for dental casting seldom exceed about 50 gm. wt., and melting is rapidly achieved with simple compressed-air/coal-gas torches. A little proprietary reducing flux or plain borax glass is usually applied in the early stages of melting to clear oxide films, but as the charge becomes fully molten the metal can be kept bright and oxide free by manipulation of the flame. Dental alloys are usually self-deoxidizing, and in most cases no deoxidizing additions are made before casting. However, in some instances, it has been shown that sounder castings may be produced by the addition, immediately before casting, of 0.5 per cent. zinc to alloys which do not contain positive deoxidizers.

Dental Casting-machines

Two types of casting technique are used in dental work, each with a number of variants. The basic methods are centrifugal-casting and gas-pressure casting, both of which have long been in use. With the development of modern casting-machines, however, the centrifugal technique is expanding at the expense of the gas-pressure techniques.

Gas-pressure Casting

Gas-pressure casting is achieved either by air or steam pressure, the latter being the more commonly used. In these techniques the metal is melted in a cavity formed in the top of the mould, the molten metal being prevented from entering the mould by using sprues of too small a diameter to allow it to enter by gravity (the maximum sprue diameter useable is about $\frac{1}{16}$ in.). If it is desired to use heavier sprues, it is necessary to provide a short length of narrow sprue between the melting crucible and the main sprue. Failure to provide adequate sprueing when using this technique is a frequent cause of shrinkage porosity in heavy castings. In the steam-pressure technique commonly known as "Solbrig" casting, the metal is forced into the mould by pressing a pad of wet asbestos over the molten metal in the top of the mould. With the air-pressure technique a similar but dry asbestos pad seals the top of the mould, and a valve is opened to admit a few atmospheres of air pressure on to the metal from a small reservoir previously loaded with a hand-pump. Although limited by difficulties of adequate feeding of large castings, these processes are surprisingly efficient methods of filling moulds. Herbert and Thompson[2] have shown that with controlled technique the mould space is filled in the order of $\frac{1}{10}$ sec., and maximum pressures up to 18 lb. per sq. in. may be developed with steam.

Centrifugal Casting

The centrifugal techniques are as old as dental casting itself. Originally, the metal was melted in a cavity in the top of the mould as in the "Solbrig" technique. When ready for casting, the mould was swung by hand on the end of a length of chain or on the rim of a cycle wheel turned by hand. Crude as these devices were they were effective, and hand swingers are still sold to-day which are virtually identical to those used 50 years ago. Most centrifugal-casting machines of to-day, however, are arranged for melting in a separate crucible, which gives greater flexibility in providing adequate sprueing and feeding arrangements in the mould, though advantage is not always taken of this facility. There are many different designs of spring-driven casting machines, all working on the same general principle of obtaining rapid initial rotation by the release of a tensioned spring, followed by a period of free-wheeling motion. Machines rotate on a horizontal or vertical axis, and, contrary to the terminology used in centrifugal foundries, those with a vertical axis of rotation are known as horizontal machines and *vice versa*. In dental practice the horizontal type of machine is most commonly used, the arm of these machines often being hinged to prevent the metal flying over the side of the crucible at the moment of release.

Finishing

When casting is complete, it is usual to quench the whole mould in cold water when the exposed surface of metal has cooled to a dull red heat. This treatment not only helps to disintegrate the investment, but also serves to arrest the hardening which occurs in most gold dental alloys when they are slowly cooled through the temperature range 500 to 300 deg. C. Castings are finally freed from adhering investment by scrubbing and pickling in hydrochloric acid, which also removes any sulphide or oxide films present.

In order to ensure a precise fit, no extensive finishing is applied to the surface of castings where they have to contact tissue in the mouth. The exposed parts of the appliance are highly polished by conventional techniques, but to aid adhesion the matt-cast finish is left on those areas which are to be covered with acrylic resin or porcelain.

JEWELLERY CASTING

Although sand-casting and cuttlefish-casting have been used in jewellery manufacture for a very long time, investment-casting is a comparatively recent development and has only become widely used since the war. Melting and casting techniques used by

jewellers have been developed from the well-established dental procedures, but the whole key to the satisfactory use of the process in jewellery manufacture was the development, by Jungersen[3] in the nineteen thirties, of the technique of making wax patterns in flexible dies.

Jewellery Dies

Most jewellery patterns are too complex to make in simple rigid dies, and multi-part machined metal dies would be far too expensive for the relatively small-scale multiple-production runs of the jewellery manufacturer (and quite impossible if only half a dozen small castings were required). Flexible rubber dies, however, can cope with the most complex patterns, usually in a two-part die, at a cost of only a few pence for materials, and half-an-hour's semi-skilled labour. The starting point of a jewellery die is a metal pattern. In the best technique this will be hand-made and finished to the highest jewellery standards, and will incorporate suitable sprues tailored into the pattern. The pattern may, however, be an item made by some other technique such as stamping, or an old item of jewellery of which reproduction is required, or possibly a finished and modified casting from an earlier pattern. In order to avoid attack by sulphur compounds in the rubber, patterns are frequently rhodium-plated.

Sprueing

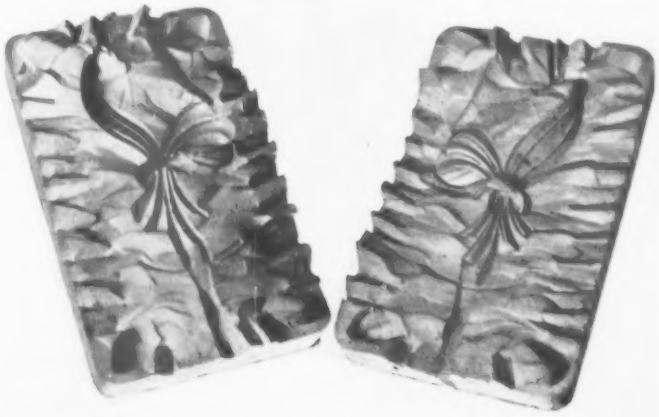
Sprueing is not always carefully considered in jewellery casting. In some cases due regard is given to metal flow and progressive solidification in the design of the pattern and sprue, but too often the sprue consists of an odd length of wire soldered to some convenient part of the pattern, having regard to ease of cut-off and finishing rather than proper feeding of the casting. It should be remembered, however, that jewellery castings are not subjected to mechanical testing or X-ray inspection, and considerable internal porosity can be tolerated as long as the surface skin is sound enough to permit proper finishing. Another point acting against the use of heavy feeding-systems is that the additional weight of precious metal required may represent a considerable capital outlay for a small manufacturer.

Rubber Dies

Rubber dies are made in simple, open, two-part aluminium frames. In the most popular technique the master pattern, supported by its sprue (which is fitted in a hole drilled between the frame halves), is surrounded by sheets of specially-compounded raw rubber, which fill the space in the frame, with a slight excess. The frame is closed by flat plates and then subjected to heat and pressure in an electrically - heated, thermostatically - controlled hand-press. The usual vulcanizing temperature is 150 deg. C., and for a mould half-an-inch in thickness 30 min. is given under pressure at this temperature, with slightly longer times for larger dies. This treatment results in a solid block of rubber enclosing the pattern and reproducing its finest detail. The rubber is now cut open, starting from the exposed sprue end, using a surgical scalpel. During cutting, registration locks are cut at the edges or corners of the die, and by working up the sprue and around the pattern the die is split along the parting line, which is pre-determined from previous experience. Usually one half of the die is first released from the pattern and then more extensive cuts are made to completely free the other half. Release of the pattern can be facilitated by lubrication, before vulcanizing, with a trace of silicone mould-release agent. With very complex patterns such as eternity rings, extensive cutting of the rubber is required to release the pattern—still further cuts may be needed to enable the wax patterns to be removed without distortion, and to act as vents to release air during wax injection. If, however, the rubber is stretched during cutting and a sharp tool is used, no sign of the parting line or other cuts should be visible on the pattern.

Metal Inserts

Where extra precision, delicate cores, or collapsible cores are required in a die, metal inserts may be used. The inserts are placed in the appropriate parts of the pattern before enclosing in the rubber, and withdrawn from the vulcanized block, where possible, before the rubber is cut. The inserts are replaced in the finished die for wax injection. In jewellery production, this technique is particularly useful for casting the fine tubes or cheniers frequently used for hinges of various types. By means of steel-wire inserts in the die, accurate cheniers as small as $\frac{1}{32}$ in.-dia. can be obtained on



Typical rubber die for the production of a jewellery wax pattern.

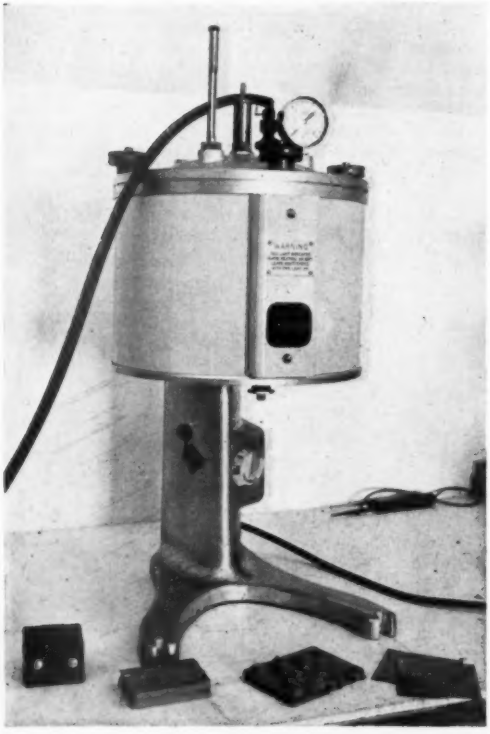
a pattern and successfully cast, so that no reaming or drilling is required on assembly of the piece.

Jewellery Patterns

Jewellery casters use the same types of wax as industrial casters, but employ different injection techniques. As rubber dies are flexible, high-pressure wax-injection would result in distortion, so injection pressures do not exceed 12 lb. per sq. in. Wax is injected in the fully fluid state, using small air-pressure injectors with spring-loaded valves (or in an older technique by means of a small-centrifugal-casting machine), the wax being ladled into the crucible of the machine from a thermostatically-controlled holding-pot.

Moulds are held between flat metal plates during wax injection, and as long as there is a good bearing area of solid rubber around the pattern cavity no significant distortion occurs. The removal of the wax pattern from the die is accomplished by suitably flexing the rubber, and is facilitated by the use of talc or silicone fluid as a die lubricant. In small-size jewellery dies the wax rapidly solidifies, and a good operator working two or three dies in sequence can achieve high production rates.

Wax injector for use with the rubber dies employed in the jewellery investment-casting industry.



Setting up the Pattern

Two main techniques of setting up patterns for investing are used in jewellery practice. The patterns may be set up vertically and attached directly to a cone sprue base or feeding disc, or they may be arranged in fir-tree formation around a central vertical main sprue. The latter technique enables more patterns to be packed into the mould space than the former but results in less satisfactory feeding, particularly in the lower parts of the mould, and the direct feeding technique is preferred for casting the more critical high-melting-point jewellery alloys. As mentioned above, elaborate feeding techniques are seldom used, and risers are practically unheard of. As casting is invariably by a pressure technique, vents are hardly ever used or required. Jewellery moulds are invariably made in metal rings, and stainless-steel or other heat-resistant alloys have become preferred for this purpose. These casting flasks, which are usually lined with thin asbestos-paper, seldom exceed 6 in. in either height or diameter, and are usually smaller. Most jewellery castings, however, are very small by industrial standards, and a hundred or more separate patterns may be enclosed in a single mould.

Plaster/Silica Investment

Single-coat investments are the general rule in jewellery practice, and there are two main types of material in use. Firstly, for gold and silver alloys melting at temperatures up to about 1,100 deg. C., plaster/silica investments are most widely used. Originally, dental investments were used, but these set so rapidly that the time available for investing and de-aerating the mould was severely limited, permitting only one or two moulds to be made from each batch of investment mixed. Further, as these investments are designed primarily for use in the form of thick pasty mixes they are less satisfactory, with regard to quality of surface finish and resistance to cracking, when used with a higher water-content to give the fluid slurry required for investing jewellery patterns. With the increase in demand, plaster investments are now available which are compounded expressly for jewellery and industrial casting. These investments are intended for use as fluid slurries, and by the use of appropriate addition agents the setting time is extended to permit the investing procedure to be fully completed before setting commences. Less attention is paid to compensation of casting shrinkage than in dental materials, as dimensional accuracy is of minor importance in jewellery, and in any case it is possible to incorporate allowances for shrinkage when making the pattern. These investments are simply mixed with water, and are not critical in their powder/liquid ratio. Their main disadvantage is that if they are used for high-melting alloys, breakdown of the calcium sulphate of the plaster occurs, resulting in sulphur contamination of the metal.

Finely-ground Refractory-powder Investment

The second type of investment was developed primarily for casting platinum and palladium alloys, which may be poured at temperatures up to

about 1,900 deg. C. It has, however, been adopted by some casters for casting the full range of jewellery alloys, and also been used with success for stainless-steel, brass, stellite and other base-metal alloys. This type of investment, which again is a single-coat material mixed only with water, is cheap and simple to use, and forms slurries with excellent flowing properties which enable it to reproduce the finest surface detail with a high-quality finish. Unlike the plaster-type investments, however, it is necessary to control the powder/water ratio carefully, and mechanical mixing is desirable to achieve consistent results. On the other hand, while mixing is continued the investment does not set and, unlike plaster, large quantities can be mixed at one time and used over a period. Basically, these investments consist of a finely-ground refractory powder mixed with water. If the powder is of sufficient purity and of the correct particle size, when it is mixed with the minimum quantity of water a heavy but free-flowing slurry results, which on standing settles to a compact mass, excess water rising to the surface or being absorbed by a porous mould base. Although no actual bonding material is present, the refractory mass has sufficient strength for normal handling in the green state, due to the close packing of the particles, and increases in strength on firing.

Purifying Addition

Normally, refractory powders are insufficiently pure to behave in this way in aqueous slurries, but it has been found that the incorporation of a small addition of sodium hexametaphosphate (often less than 0.1 per cent.) into the refractory powder, or in solution in the mixing water, eliminates the effect of the normal impurities in the refractory[4]. Investments based on silica, sillimanite and zircon have been used in this way, but for jewellery purposes the silica-base material is normally employed.

Jewellery Investing Technique

Similar investing techniques are used for both types of investment. The main problem in the investment of jewellery patterns is the elimination of air bubbles trapped in the interstices of the patterns. With complex and light jewellery patterns vibration techniques are ineffective in dislodging trapped air, and delicate patterns are liable to be broken by such treatment. This problem is tackled in jewellery techniques by vacuum treatment of the liquid investment. Plaster investments are subjected to vacuum twice, once in the mixing bowl to remove air bubbles entrained in mixing, and once in the mould after the patterns have been just covered with investment. Following this treatment the mould is topped up with further investment from that previously treated.

The high-temperature investments are more fluid than the plaster types, and air entrapped during mixing rises to the surface on its own. In this case it is only necessary to apply vacuum treatment to the partly-filled mould to remove air adhering to the patterns, and no difficulty arises in topping the moulds with untreated investment. The degree of vacuum applied is important, and to ensure total removal of air it is necessary to submit the investment to a vacuum high enough to boil the water. The steam bubbles so formed help to sweep away the last traces of air.

Typical jewellery wax-pattern cluster, shown ready for investing.

Setting of the small-size jewellery moulds is quite rapid. Plaster investments set in about 30 min. or less, and the high-temperature investments in two to six hr. depending on mould size and atmospheric conditions. The commonest practice is to make moulds one day, allow them to stand overnight, and fire and cast the next day.

Firing of Moulds

The firing of jewellery moulds follows conventional procedures. Usually, moulds are de-waxed in a low-temperature oven before final firing, though wax recovery is not practised. Gas and electric furnaces are about equally favoured for final firing, the choice being most often governed by facilities and finances available rather than technical considerations. Moulds in both types of investment are fired to 700-800 deg. C. for casting. With the lower-melting-point carat-gold alloys, it is necessary to allow considerable cooling of the mould before casting can be carried out. Mould temperatures for casting are generally 500 to 600 deg. C. for 9-carat-gold alloys, 600 to 700 deg. C. for 18-carat-gold and silver alloys, and 700 to 800 deg. C. for white golds, palladium and platinum alloys.

Jewellery Alloys

The whole range of jewellery alloys may be successfully cast, and it has not been necessary as a general rule to introduce new alloys especially for casting. In terms of melting points, these alloys range from the 9-carat or 37.5 per cent. gold alloys melting at about 800 deg. C., to the 90-per cent. platinum/10 per cent. iridium alloy which has a liquidus temperature of 1,800 deg. C. With the

exception of some white-gold alloys, all the jewellery alloys are quite ductile in the cast condition, and are used in that state.

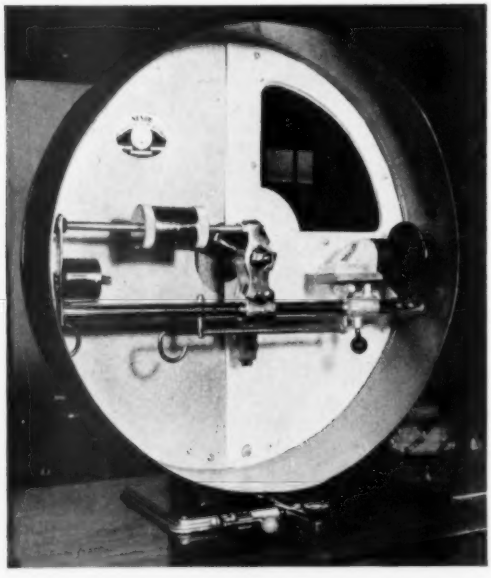
Alloy Melting

In the early days of jewellery casting all alloys were torch melted, and the majority of castings are still made in this way. For gold and silver alloys in moderate quantities, say up to about 100 gm.wt., air/coal-gas torches are used similar to those employed in dental casting. For large melts of these alloys, which may be up to 300-400 gm. of 18-carat gold, oxy/coal-gas torches are needed. For platinum, palladium, and palladium white-gold alloys, oxy/coal-gas torches are essential. The most suitable type of torch is a low-pressure oxy-acetylene welding torch which, when used with oxygen and normal mains-pressure coal-gas, gives a far more suitable flame for melting these alloys than do the torches sold as oxy/coal-gas torches.

Oxidizing

The majority of jewellery alloys are easy to melt. They give little trouble with gas porosity, are not prone to slagging, need no de-oxidizing, and require only minimum fluxing with a simple borax flux. An exception to this is the standard palladium jewellery alloy 95.5 per cent. palladium/4.5 per cent. ruthenium. If melted under reducing conditions, castings in this alloy are liable to be hot-torn, due to silicon and/or sulphur pick-up. Therefore, the alloy is melted under strongly oxidizing conditions, and de-oxidation with a small addition of aluminium prevents gas porosity arising from rejection of oxygen dissolved in the melt. Residual aluminium is fluxed from scrap melts by use of an oxidizing fluoride flux.

Vertical centrifugal-casting machine used in jewellery work in conjunction with torch melting.



Casting Machines

Centrifugal casting is always used in jewellery investment-casting practice. With torch-melting, spring-driven machines are used, frequently horizontal machines similar to those employed in dental practice, though often in larger sizes taking up to 400 gm. of 18-carat gold. A popular type of machine, particularly favoured for platinum and palladium alloys, rotates in the vertical plane. This unit has been more developed than the horizontal types, and has a particularly fast take-off coupled with ease of loading and accessibility for melting.

Various electric-melting techniques incorporated in centrifugal-casting machines are now available for jewellery alloys. One type of machine incorporates a small but efficient high-frequency induction-melting unit, the coil of which is automatically retracted from the melting crucible as a motor drive starts the casting arm rotating. This machine gives very rapid melting, with close control of melting atmosphere and ready accessibility of the melt at all times. It is particularly suitable for the higher-melting jewellery alloys.

Another machine melts by means of a carbon resistance furnace. This furnace is mounted vertically on a motor-driven horizontal turn-table. The mould is clamped on top of the furnace for casting, the furnace/mould assembly being tilted to the horizontal for pouring by means of an hydraulic cylinder when the turn-table has reached the required speed. This machine is suitable for melting gold and silver alloys, but owing to the inevitable reducing atmosphere is not suitable for platinum and palladium alloys, due to reduction of the refractories at the higher temperatures involved.

A third type of machine employs vacuum- and centrifugal-casting combined. In this machine the charge is melted in air in a "Kanthal" wound resistance furnace contained in a vacuum chamber which is counter-balanced and mounted on trunnions. When the charge is molten, the mould is clamped to the open furnace-top, the vacuum chamber being sealed and evacuated by means of a rotary vacuum pump. When the required vacuum is reached, the furnace connections are broken and the assembly spun by hand on its trunnions to make the casting.

Applications of Jewellery Castings

Jewellery castings have a high-quality finish by industrial foundry standards but, nevertheless, they are normally polished all over by conventional jewellery techniques before use. In fine jewellery production, castings may be subjected to considerable deformation, engraving or carving before final finishing, and may be externally indistinguishable from a hand-made piece.

Investment casting finds widespread use in jewellery manufacture, *e.g.*, cast charms, earrings and

brooches. Other items made this way are: settings of gem-set rings; repeated motifs in large jewellery suites and watch bracelets; watch cases, ornamentation in silverware, and pieces used in conjunction with wrought materials. Investment casting is even being used to produce single items, to eliminate extensive carving of expensive metal or to enable complex pieces to be made directly from designers' hand-carved wax patterns.

Acknowledgments

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REFERENCES

[1] Lufkin, A. W., *A History of Dentistry* (2nd edition), 298, published by Henry Kimpton, London.
[2] Herbert and Thompson, *Proceedings of the Royal Society of Medicine*, 30, 245.
[3] British Patents 449,062 and 503,537, U.S. Patents 2,354,026 and 2,362,136.
[4] British Patent 715,020.

Publications Received

European Investment Casters' Association—Proceedings of the 1959 Conference held at Essen, June 1 to 3. The Proceedings* of the 1959 conference of the European Investment Casters' Association are now to hand, and praise is due to those responsible for publishing them relatively soon after the conference. The Proceedings are mimeographed and the papers presented are published in each author's language. The volume opens with a list of participants attending the conference and then follows a resumé of the programme arrangements, and also notes about the works visited.

The following papers presented at the conference are included in the Proceedings: "Attitude of Gunsmiths to Investment Castings," by P. Mathy (in French); "Batten-Cordonnier System for the Classification of Technical Literature," by C. Jouwersma (in German); "Position of (German) Specifications for Investment Castings," by Dr. E. G. Nickel and Dr. W. Bochum (in German); "Estimation of the Temperature of a Melt," by H. J. Meerkamp van Embden (in English); "Investment Casting Alloys for Service at Elevated Temperatures," by D. R. Wood (in English); "Technical Communications between Investment Founders and their Customers," by R. Schwedes (in English); "Investment Casting of Precious Metals†" by P. E. Gainsbury (in English); "American Investment Casting Industry," by R. Waindle (in English); "Wax Moulding and Dimensional Tolerances," by C. Nieuwenhuis (in English); "Selling Investment Castings," by W. Zwerner (in French); "Dies for Investment Castings Patterns," by Dr. E. Hengler (in German); "Ethyl Silicate as a Binder for Refractory Materials," by J. I. Evans (in English); "Art Founding of Cast-iron in the 19th and 20th Centuries," by Dr. S. Theisen (in German). The Proceedings have been issued from the office of the president of the Association, Mr. H. J. Meerkamp van Embden at Philips Gloeilampenfabrieken, Eindhoven, Holland.

* The conference was reported fully in this JOURNAL dated September 3, 1959, and synopses of the papers were included.
† Printed on pages 11 to 19 of this JOURNAL.

British Standard 3156:1959—Methods for the Sampling and Analysis of Fuel Gases. Published by the British Standards Institution, 2, Park Street, London, W.1.

This standard is the second of a series of B.S. methods for the sampling and analysis of gases of which the first, B.S.1756:1952, dealt with flue gases. The term "fuel gas" is applied to any gas which burns. The standard describes only well-established methods, and does not deal with such methods of gas analysis as those involving low-temperature fractionation, infrared or ultra-violet spectroscopy, polarography, interferometry, chromatography, etc. It is divided into three main parts, *viz.* (i) sampling; (ii) general analysis (carbon dioxide, oxygen, unsaturated hydrocarbons, hydrogen, carbon monoxide, saturated hydrocarbons and nitrogen) and (iii) special determinations (sulphur compounds, condensible vapours (benzole), nitrogenous gum in purified gas, tar fog in crude gas, ammonia, naphthalene, hydrogen cyanide, iron carbonyl, specific gravity, calorific value, hydrocarbon-enrichment value, aeration test burner (A.T.B.) number. Apparatus, reagents and procedures are given in detail. The publication provides a compact and authoritative source of reference which will be a valuable aid to the fuel technologist.

Operation of a Company Standards Department. Published by the British Standards Institution (address above).

This is acclaimed to be a very important publication, since by the proper organization of internal standards much money can be saved. Standards engineers have existed for 40 years and their number is growing. After studying this pamphlet and listening to a discussion on the subject, the reviewer is convinced that it is a very important document for engineering firms and foundries of the mechanized type, but he fears that, for the jobbing foundry, the preliminary purchases required are such as to minimize any potential benefits. In mechanized foundries, it would certainly be worthwhile for an executive to standardize such things as the spring-loaded pins used in connection with shell moulding, conveyor rollers, and similar items which require periodic replacement.

Safety, No. 7. Published by the Accident Prevention Committee of the British Iron and Steel Federation, Steel House, Tothill Street, London, S.W.1.

There are two articles in this issue which extend beyond the confines of iron and steel manufacture and are of interest to the foundry industry. They cover the Factory Acts Amendments and here the meaning of the new Act is explained by Mr. D. C. Baines, Under-Secretary, Safety, Health and Welfare Department, Ministry of Labour. The effect of the changes on industry is outlined by Mr. N. H. Jones, C.B.E. Actually, some of the Regulations already applicable to iron and steel foundries are extended to industry in general; there are, however, new ones connected with fire-precautions and first-aid services.

Steel Review, Vol. 3, No. 6. Published by the British Iron and Steel Federation (address above).

This issue contains an important article on "Revolution in Steelmaking," which deals with the application of tonnage oxygen. It has more than general interest for the steelfounder, who is of course interested in increased production and elimination of impurities.

THE RICHARDSON WESTGARTH GROUP announce that their marine companies have obtained orders for five engine installations worth more than £2,500,000.

Notes from the Branches

Natal Section

At the October meeting of the Council of the South African branch of the Institute of British Foundrymen, approval was given to the full status of "Section" being granted to the body of Natal foundrymen who have, for the past year, under the guidance of the South African branch, been holding meetings and works visits, as well as recruiting many new members for the Institute. A general meeting of the provisional section was held in November and at this meeting the actual announcement of the granting of official status was made. The chairman on this occasion was Mr. R. C. Cross, immediate past-president of the South African branch.

Chairman's Report

A report of activities during the previous twelve months was presented by Mr. James Robertson, who had been chairman of the provisional body. In his introductory remarks, he stated that the granting of official status was due in no small measure to the unfailing support and enthusiasm of the members, the diligence of the committee, and last, but not least, the honorary secretary, Mr. John Richmond. At the close of the first inaugural meeting in November, 1958, he said, there had been a total number of only 17 members in Natal—this figure had now increased to 51, plus two subscribing firms. This membership represents practically every foundry and associate industry in Natal. Mr. Robertson then expressed his appreciation to the South African branch for providing the section with lectures and material for their various meetings.

Election of Officers and Council

The following were then elected to form the first Council of the Natal section: President: Mr. J. Robertson; senior vice-president: Mr. A. W. Bird; junior vice-president: Mr. G. Thomson; secretary: Mr. J. H. Richmond, and as members of Council: Mr. A. Johnson, Mr. F. Rice, Mr. A. Paterson, Mr. H. Merryweather, Mr. D. Russell, Mr. A. Mitchell, Mr. T. Snyman, Mr. J. R. Walton and Mr. J. Mathie.

A vote of thanks was proposed to Mr. R. C. Cross for conducting the meeting, to Mr. J. Robertson (chairman) and Mr. A. W. Bird (vice-chairman) for the management of the section during its first probationary twelve months, and to Mr. J. H. Richmond for his hard work and untiring efforts as secretary.

Inaugural Dinner

The inaugural dinner was held on December 3 in the Killarney Hotel, Durban. Mr. D. Gordon Jones, senior vice-president of the South African branch, presided over an attendance of 48 members and guests. Mr. A. W. Bird proposed a toast to the guests, who included representatives from kindred technical societies and educational bodies in Natal, as well as Mr. D. Gordon Jones, Mr. R. C. Cross and Mr. John Steele from the South African branch. The reply to the toast was made by Mr. Steele. Before installing Mr. Robertson as the first section president, Mr. Gordon Jones complimented the section on having achieved official status, and on having conducted a full season's work with sustained enthusiasm. He stressed that the test of the success was gauged by the month-to-month attendance at general meetings, the maintenance of good membership and the quality of papers presented. On behalf of the South African branch, he stated that they would provide all the assistance in their power. He also commented on the recent up-grading of Institute membership requirements, and said that as members were entitled to append respective letters after their names, it was necessary to ensure that they were really regarded as an indication of the individual's qualifications. He concluded by complimenting Mr. Robertson on his appointment as president.

A brief inaugural address was presented by Mr. Robertson, in which he thanked the members for their confidence in electing him as president. He appealed to members to attend the meetings regularly, to offer papers, and to present problems which, in their subsequent discussion and solutions, would assist to promote the Institute's motto: "Science Hand in Hand with Labour." He suggested that it would be a good policy for the section to arrange joint meetings from time to time with kindred technical societies, for the presentation of papers which were of mutual interest. He also suggested the possibility of arranging an apprentice competition for the production of art castings.

Mr. Robertson then called on Mr. Morris Gray, president of the Natal Institute of Engineers to address the gathering. During the course of his remarks, Mr. Gray complimented the foundrymen of Natal on the class of work currently being produced in the foundries, and stated that in his trade of electrical and mechanical engineering the value of foundry work, and quality of castings produced, was fully appreciated. Mr. Robertson then concluded the proceedings.

AFS Congress and Exhibition

As already announced in the JOURNAL, the 1960 castings congress and exhibition organized by the American Foundrymen's Society, is to be held from May 9 to 13, in Philadelphia's Convention Hall. Mr. W. Maloney, the general manager, states that at the present high rate of interest the exhibition space will be sold out well in advance of the opening day.

He also reports that an unusually high percentage of exhibitors at the 1960 show intend to display products never before demonstrated. The vigorous growth of foreign competition, he said, spurred by lower transport costs *via* the St. Lawrence Seaway, plus cumulative effects of the steel strike, have caused many US foundries to purchase equipment abroad. As a result, many American firms are designing drastically new concepts of foundry operations into their products. Among the many new developments to be shown next May will be the broader use of electronics for controls and automated operations; unusual means of testing for quality control; improvements on X-ray and other non-destructive testing methods; a completely automated moulding-pouring-shakeout system; improved means of dust- and fume-control, shop ventilation, and air-pollution control; new noise-absorption materials; built-in safety devices; new types of materials-handling equipment, speedier, more selective sand-distribution systems, and new materials for dry- and green-sand moulding, core-making, shell moulding and patternmaking.

Dip. Tech. Awards

The list of the awards of the Diploma in Technology from the Birmingham College of Advanced Technology covering metallurgy includes the following: *First Class Honours*—Mr. B. G. Harrison (Imperial Chemical Industries, Limited). *Second Class Honours (Division I)*—Mr. R. T. Derricott (Tube Investments, Limited) and Mr. D. A. Hewston (I.C.I.). *Second Class Honours (Division II)*—Mr. K. A. Harrison (Joseph Lucas, Limited) and Mr. T. J. Pitt (Guest, Keen & Nettlefolds, Limited). *Pass level*—Mr. P. J. Higgins (Joseph Lucas)

New Year Honours

Awards to Personnel in Foundry, Iron & Steel and Kindred Industries

Among the 2,000 men and women figuring in the New Year Honours List are many in the spheres of industry and commerce, including a number prominent in the foundry and iron and steel industries. Among them are Baron Rochdale, a director of the Consett Iron Company, Limited, who receives a viscountcy, and the well-known industrialist and chairman of the English Electric Company, Limited, Sir George Nelson, who is made a baron. Details of some of the principal awards, with notes on the recipients, are given in what follows:

VISCOUNT

Baron ROCHDALE, chairman of a number of companies, a director of the Consett Iron Company, Limited, since 1956, chairman of the Cotton Board, a governor of the British Broadcasting Corporation, and a member of the Dollar Exports Council since 1953. He was president of the National Union of Manufacturers from 1953 to 1956.

BARON

Sir GEORGE HORATIO NELSON,* a prominent industrialist, is chairman of the English Electric Company, Limited, its associated companies and subsidiaries, and a director of Micanite & Insulators Company, Limited, and Lloyds Bank, Limited. He has held or holds a large number of offices in scientific, technical, and industrial associations and has served on many Government committees. He is a past-president and a member of the Grand Council of the Federation of British Industries, a past-president of the Institution of Mechanical Engineers, a member of the Council of the British Electrical and Allied Manufacturers' Association, a past-president and a member of the Council of the Institution of Electrical Engineers, a former member of the general board and executive committee of the National Physical Laboratory and the technical committee of Lloyd's Register of Shipping.

Responsible for the manufacture and installation of steam and hydro-electric equipment and electric traction equipments in various parts of the world, Sir George was chief outside engineer and later chief electrical superintendent of the British Westinghouse Company, Limited, before becoming manager of the Sheffield works of Metropolitan-Vickers Electrical Company, Limited, in 1920. He was appointed managing director of English Electric in 1930, and chairman in 1933, relinquishing the former office in 1956.

BARONETS

Mr. DONALD KABERRY, Conservative M.P. for North-West Leeds since 1950, and joint vice-chairman, Conservative Party Organization, since 1955, is chairman of W. H. BAXTER, Limited, engineers, ironfounders, and manufacturers of stone-breaking machinery, of Leeds, and a director of the Yorkshire Dyeware & Chemical Company, Limited.

KNIGHTS BACHELOR

Dr. WILLIAM HENRY GLANVILLE, director of road research of the Department of Scientific and Industrial Research and an authority on highway construction and soil mechanics. He is a member of the committee of the International Association of Bridge and Structural Engineering, the British Standards Codes of Practice Committee, and the board of the British Nuclear Energy Conference. He is a past-president of the Institution of Civil Engineers.

Mr. JOSEPH LATHAM, deputy chairman of the National Coal Board, has been associated with the industry since 1935. On nationalization of the industry he was appointed director-general of finance of the National Coal Board and served in this capacity up to the reorganization of the NCB in 1955, when he became a full-time member of the Board, becoming deputy chairman in the following January. He is an original member of the Clean Air Council since its formation in 1957.

Mr. JOSEPH FLAWITH LOCKWOOD, chairman of Electric & Musical Industries, Limited, and other companies, and a director of Henry Simon (Holdings), Limited, flour and provender milling engineers and makers of grain silos, handling plant, etc., of Stockport (Ches). He has been a director of the National Research Development Corporation since 1951. A director of Henry Simon (Engineering Works), Limited, he was appointed chairman and managing director of Henry Simon, Limited, in 1950 and has been chairman of EMI since 1954.

Mr. RONALD PETER MORISON, independent chairman of the executive committee of the British Iron and Steel Federation since 1955, and well known in the field of arbitration. Mr. Morison, who is 59, was called to the Scottish Bar in 1923 and to the English Bar in 1940. He was a member of the Industrial Disputes Tribunal from 1944 to 1954 and in the following year a deputy commissioner under the National Insurance Acts.

Mr. CHARLES FREDERICK TRUSTAM, chief general manager of the Royal Insurance Company, Limited, and a director of British Electrical Repairs, Limited, Manchester, and British Engine Boiler & Electrical Insurance Company, Limited.

Mr. ARTHUR BERTRAM WARING, chairman and managing director of Joseph Lucas (Industries), Limited, and chairman of C.A.V., Limited, Girling, Limited, and Rotax, Limited. He is a director and a member of the Birmingham committee of Lloyds Bank, Limited. Mr. Waring, who is 66, qualified as a chartered accountant in 1920 and joined Joseph Lucas (Industries) in 1922. He has been chairman and managing director of the company since 1951. He is a past-president of the Birmingham and District Engineering and Allied Employers' Association, the Birmingham Chamber of Commerce, the Society of Motor Manufacturers and Traders, the Institute of Industrial Supervisors, and vice-president of the Institute of Works Managers.

ORDER OF THE BATH

CB

Mr. ERNEST JOHN MEADON, accountant-general and under-secretary for finance, Ministry of Power, since 1955. Mr. ROGER NATHANIEL QUIRK, under-secretary, Ministry of Fuel and Power, from 1948 to 1952, and now under-secretary, office of the Minister for Science. Mr. ROBERT HENDRY WEIR, director-general of engine research and development, Ministry of Aviation, and

* Sir George Nelson's career was featured in the JOURNAL of August 2, 1956.

New Year Honours

formerly assistant director of the Ministry of Aircraft Production, director of industrial gas-turbines, and director of engine research and development. He was educated at Glasgow University and served his engineering apprenticeship with William Denny & Bros., Limited, Dumbarton, Scotland.

ORDER OF THE BRITISH EMPIRE

Civil Division

KBE

Rear-Admiral Sir MATTHEW SAUSSE SLATTERY, chairman and managing director of Short Bros. & Harland, Limited, aeronautical engineers, Belfast, and until recently special adviser to the Prime Minister on the transport of Middle East oil. Sir Matthew is also chairman of Bristol Aircraft, Limited, S.B. (Realisations), Limited, and a director of the Bristol Aeroplane Company, Limited. Since 1941 he has held a number of important Admiralty and Supply appointments.

CBE

Mr. S. C. BOND, president of the Traders' Road Transport Organization (and transport manager, Stewarts and Lloyds, Limited, and a member of the Council Ironfoundry Association's transport committee; Mr. D. D. CRUICKSHANK, general manager of the Renfrew, Dalmuir, and Dumbarton Works of Babcock & Wilcox, Limited, founders boilermakers, and engineers, manufacturers of cranes and mechanical-handling plant, etc. Mr. Cruickshank was for several years deputy general manager of the East Indian Railway and subsequently a director of Sir William Arrol & Company, Limited, Glasgow bridgebuilders and engineers. He was appointed to his present post in 1953. Mr. L. J. DAVIES, director of research and education, British Thomson-Houston Company, Limited, electrical engineers and manufacturers, of Rugby, and of A.E.I. Lamp & Lighting Company, Limited, and Glass Bulbs, Limited. Mr. N. P. NEWMAN, J.P., chairman and managing director of Newman, Hender & Company, Limited, iron and non-ferrous founders, of Stroud (Glos), and of its overseas organizations. He is also chairman of George Clark & Sons, Limited, Parry Pumps, Limited, Shipham & Company, Limited, Vee Reg Valves, Limited, and chairman and managing director of N.H. Engineering, Limited. Mr. Newman is president of the Joint Iron Council, vice-president of the Engineering Employers West of England Association, and vice-chairman of the British Valve Manufacturers' Association, and served as chairman of the Council of Ironfoundry Associations from 1949 to 1958. A past-president of the Institute of British Foundrymen, Mr. Newman is now honorary treasurer of the Institute, and is also a Council member of the British Cast Iron Research Association. Mr. A. J. NICHOLAS, managing director of South Wales Switchgear, Limited, is also joint managing director of Aberdare (Holdings), Limited. He is a member of the boards of Aberdare Cables, Limited, Electric Switchgear Montreal (1953), Limited, Neptune Brass & Aluminium Company, Limited, and Treforest Electrical Services, Limited. He was the 1958-59 president of the South Wales branch of the Incorporated Sales Managers' Association and is an original member of the Development Corporation for Wales. Mr. H. E. PEIRCE, a managing director of Hall & Company, Limited, builders' merchants, of Croydon (Surrey), and chairman of the executive council of the National Council of Building Material Producers. Mr. Peirce is also chairman of the Sand and Gravel Association of Great Britain, and a director of a number of companies in that field. Mr. H. T. PLEDGE, Keeper of the Science Museum, South Kensington, since 1945. Mr. H. T. RAMSAY, director of the Safety in Mines Research Establishment, Ministry of Power, since 1955. Mr. Ramsay, who is 52, graduated from London University and served for much of his career under Sir Clifford Patterson at the research laboratories of the General Electric Company, Limited. His work on the application of the discharge in gases to high-voltage rectification led to valuable research on radar. After five years at the Royal Aeronautical Establishment he joined the Ministry of Supply and in 1955 took up his present work with the then Ministry of Fuel and Power. Ald. B. RAMSEY, chairman of the Middlesbrough Education Committee, is a steelworker and has held national office with the British Iron and Steel and Kindred Trades Association. He has been a member of the Town Council since 1928 and is chairman of the executive of the Northern Counties Technical Examination Council. Mr. W. S. ROBERTSON, secretary of the Scottish Council (Development and Industry). Mr. H. A. J. SILLEY, chairman of R. & H. Green & Silley Weir, Limited, dry dock owners, London, E.C.3, and a director of Silley Cox & Company, Limited, engineers, brassfounders and ironfounders, shiprepairers, etc., of Falmouth (Cornwall).

OBE

Military Division

Acting Wing Cmndr. CECIL EWART WHITAKER, RAFVR (Training Branch), a local director of Jessop-Saville, Limited, steel and titanium manufacturers of Sheffield, and formerly of the English Steel Corporation, Limited.

OBE

Commonwealth Relations Office

Cllr. A. L. BACKWELL, former mayor of Geelong City, Victoria, Australia, and a well-known foundryman of Geelong.

OBE

Civil Division

Mr. H. E. BARRY, manager, trade relations department, head office of Shell-Mex & B.P., Limited; Mr. A. W. H. COLE, manager of the communications division, Marconi's Wireless Telegraph Company, Limited; Lt.-Col. T. S. GIBSON, chairman and managing director of A. & J. Main & Company, Limited, structural engineers, etc., of Glasgow; Mr. W. E. GOWERS, a director and general manager at the Cwmbran Works of Girling, Limited, makers of brakes for road-vehicles and aircraft, of Birmingham, until his retirement in November, and a member and past-chairman of both the East Wales Productivity Council and the Newport and Pontypool Productivity Committee; Mr. A. E. HAHN, who is 53, has been secretary of Sheffield Chamber of Commerce since 1945; Mr. J. S. HALES, director of the industrial and domestic development laboratories of the British Coal Utilization Research Association; Mr. H. J. HAMBLIN, senior principal scientific officer, National Institute of Agricultural Engineering; Mr. P. M. HOLMAN, a managing director of Holman Bros., Limited, founders, mining- and pneumatic-plant specialists, etc., of Camborne (Cornwall), and a director of its overseas subsidiaries, managing director of Climax Rock Drill & Engineering, Limited, and a director of Dustuctor Company, Limited, and Goodyear Pumps, Limited; Mr. P. G. HORSLER, superintending inspector of factories, Ministry of Labour; Mr. J. O. PARRY, principal of J. Owen Parry & Lewis, consulting civil engineers, of Ammanford (Carmarthenshire); Mr. A. W. PLAYER, managing director for 12 years of Fleming & Ferguson, Limited,

ship and dredger builders and marine engineers, of Paisley (Renfrewshire); Mr. E. J. SCOTT, a director of Bluemel Bros., Limited, Coventry, and Dover, Limited, Northampton, motor- and cycle-accessory manufacturers; Mr. A. SYMON, manager (sales engineering), Bristol Aircraft Company, Limited; Mr. E. J. TIMBERLAKE, joint managing director of Electro Dynamic Construction Company, Limited, of St. Mary Cray, Kent; Mr. J. E. WHITTAKER, area manager of the North of Scotland Hydro Electric Board and a past-chairman of the Scottish Centre of the Institution of Electrical Engineers; Mr. E. T. WILKINS, principal scientific officer, Department of Scientific and Industrial Research; Mr. A. WILSON, principal executive officer, lately regional director (North Western Region), Ministry of Power.

MBE

Mr. A. ALLEN, chief development engineer, Cossor Radar & Electronics, Limited, Harlow (Essex); Mr. H. W. ATKINSON, senior executive officer, National Physical Laboratory; Mr. JOHN BELL, area organizer, No. 2 Area (North-Eastern District), United Patternmakers' Association; Mr. J. H. BROOKS, superintendent of engineering workshops, Cambridge University; Mr. WILLIAM BULLOCH, works director of Cruikshank & Company, Limited, cast-iron and small malleable founders, of Denny (Stirlingshire); Mr. A. G. W. CANNON, manufacturing manager of the motor and control-gear division of Associated Electrical Industries, Limited, Rugby. Mr. Cannon is also a director of the Hilltop Foundry Company, Limited, Wednesbury (Staffs); Mr. A. DRAPER, vice-principal of Rugby College of Engineering Technology and a past-president of the Rugby Engineering Society; Mr. E. J. HOCKING, electrical manager, Vosper, Limited, shipbuilders' engineers, Portsmouth; Mr. J. T. IMRIE, drawing-office consultant, Fairfield Shipbuilding & Engineering Company, Limited, Glasgow; Mr. J. V. JONES, chief information officer, BP Refinery (Kent), Limited; Mr. C. MACDONALD, a director and general contracts manager of Wailes Dove Bitumastic, Limited, Hebburn (Co. Durham); Mr. J. H. LANE-NOTT, civil-defence officer, Steel Company of Wales, Limited (Newport division). Mr. Lane-Nott, who is 39, was formerly with the Bristol Aeroplane Company, Limited; Mr. M. D. PARKINSON, head of the estimating department of T. W. Grenwell & Company, Limited, ship-, engine-, and boiler-repairers, of Sunderland; Mr. W. G. D. PHILLIPS, senior executive officer, Ministry of Power; Mr. G. H. PRINCE, head of the apparatus-engineering department of Ericsson Telephones, Limited, of Beeston (Notts); Mr. JOHN RINGLAND, assistant manager, electrical department, Harland & Wolff, Limited, Belfast shipbuilders and engineers; Mr. R. L. L. ROBINSON, regional fuel engineer, National Industrial Fuel Efficiency Service; Mr. D. RODGER, manager of the marine department of Vickers-Armstrongs (Engineers), Limited, Barrow-in-Furness; Mr. E. E. SOPP, officer-in-charge, central drawing office, Ministry of Power; Miss W. M. SPRINGFORD, principal secretary to the chairman, Imperial Chemical Industries, Limited; Mr. E. C. J. STUCHBERY, works manager, Mechanism, Limited, scientific and aero engineers, of Croydon (Surrey); Mr. W. E. WILLIAMS, principal assistant to the secretary, Bristol Channel Ship Repairers' Association.

BRITISH EMPIRE MEDAL

Mr. JABEZ BARRIE ATHERTON, electric welder, Billingham division of Imperial Chemical Industries, Limited, Middlesbrough; Mr. WALTER NORMAN COLEMAN, overhead-crane driver, Dorman Long (Bridge & Engineering), Limited, Middlesbrough; Mr. JAMES FORTESCUE CONNOLLY, senior foreman, Davidson & Company, Limited, Belfast engineers and iron-founders; Mr. HUGH CONNOR, senior deck-plater (marker), Joseph L. Thompson & Sons, Limited, Sunderland, shipbuilders.

Mr. JOHN HATHAWAY, supervisor, S. M. Wilmot & Company, Limited, metal structural and fabrication engineers, of Bristol; Mr. ALEXANDER HOOK, foreman, Brown Bros. & Company, Limited, hydraulic engineers and brassfounders, of Edinburgh; Mr. THOMAS HENRY HUNT, heavy foundry superintendent, F. H. Lloyd & Company, Limited, Wednesbury (Staffs); Mr. HENRY GEORGE JARVIS, chief stillman, Carless, Capel & Leonard, Limited, petroleum and coal tar naphtha distillers, of London, E.3; Mr. HENRY JORDAN, assistant foreman, Harland & Wolff, Limited, Belfast engineers and shipbuilders.

Mr. GEORGE EDWARD KENT, welfare liaison officer, Robert Stephenson & Hawthorn, Limited, locomotive builders, Newcastle-upon-Tyne; Mr. JOHN COOK MATHIESON, foreman, Carron Company, ironfounders and engineers, Falkirk; Mr. JOHN NICHOLSON, boilermaker's plater, Leeds & Bradford Boiler Company, Limited; Mr. THOMAS ORMEROD, foreman engineer, Grayson, Rollo & Clover Docks, Limited, shiprepairers, drydock owners, etc., of Liverpool.

Mr. JAMES BOWDEN RAITT, progress chaser, Keith Blackman, Limited, engineers and manufacturers of fans, gas-heating apparatus, etc., of London, N.17; Mr. GEORGE BELL RICHARDSON, gas welder, Ashmore Benson, Pease & Company, Limited, makers of blast furnaces, gasworks plant, etc., of Stockton-on-Tees; Mr. WILLIAM ROBERT ROWE, foreman, Whites Shipyard (Southampton), Limited; Mr. JOHN SCOTT, slipway foreman and rigger, Herd & Mackenzie shipbuilding, marine and general engineers, of Buckie (Banffshire); Mr. HARRY SMITH, shift superintendent, British Aluminium Company, Limited; Mr. HAROLD SWINDELL, patternmaker and for 40 years an employee at the Stanton Ironworks Company, Limited; Mr. ERNEST TAYLOR, foreman, Automatic Telephone & Electric Company, Limited, Liverpool; Mr. CHARLES EDWIN WRIGHT, collector, Works Savings Club, Palmers Hebburn Works of Vickers-Armstrongs (Shipbuilders), Limited.

Book Review

British Industrialists—Steel and Hosiery, 1850-1950, by Charlotte Erickson. Published by the Cambridge University Press, Bentley House, 200, Euston Road, London, N.W.1; price 40s. net.

The object of this book is to put before the reader the social background and activities of leaders of the steel and hosiery businesses over the last 100 years. This is done by means of potted biographies and tables, it being left to the reader to draw his own conclusions. In the sections devoted to steel, the book is marred by too many mistakes, *e.g.*, in the introduction, Lord McGowan appears as Lord Gowan, and the name Harry Brearley is consistently spelt Brearly. Dr. Swinden is stated as having received his doctorate at Upsala, whereas in actual fact it was from Sheffield University. The statement is made that "only one case has been found of a metallurgist who rose within the firm to become managing director," yet within the reviewer's knowledge, Dr. W. H. Hatfield had a seat on the board of Firth's, but his name does not figure in the list of industrialists. The quotation from Harry Brearley's book "Knotted String" is not too happy, as he happened to have a "grouse" with boards of directors about the exploitation of his invention of stainless-steel for cutlery. Moreover, in his time, some works managers wielded a power usually assigned to the board; names like those of Saniter, Dickenson, Cosmo Johns readily come to mind, for example. The fact of having a seat on the board does not mean the *alpha* and *omega* of a man's career, for even to-day certain Continental firms insist that these positions are reserved for people versed in finance and not technology. If this book be regarded as giving aid towards getting to the "top office," one is still left in a quandary. Samuel Fox (who founded the firm bearing his name), according to the reviewer's father, who knew him personally, never learnt to write his own name. Sir Robert Hadfield, who is only accorded a few lines in the book, was rather backward as a schoolboy and his parents were worried as to what line of business he should follow. So the story goes on, the leaders of industry being drawn from every social strata. Naturally, with changing conditions, fewer are drawn from the land-owning and farmer class.

V. C. FAULKNER.

Acknowledged with thanks . . .

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Golden Jubilees

British Piston Ring Company, Limited, Coventry

A *de luxe* 40-page brochure has been issued by the British Piston Ring Company, Limited, Coventry, mainly for distribution to employees, to celebrate the foundation of the firm 50 years ago by the late Mr. W. A. Oubridge, J.P. When he died in 1942, Mr. Oubridge had seen the firm grow from a modest workshop to a concern of national importance. The book is the history of a firm which pioneered many of the processes associated with piston-ring, piston-ring-pot and cylinder-liner developments.

There is throughout the book a full appreciation of the part played, not only by the directors, but by the staff, and the listing of about 150 names of the holders of long-service awards underlines the fact that, though now housed in a very large works, the company operates as a well-balanced team. The brochure also covers sporting activities and apprenticeship training. It is a book which will be treasured not only by staff but by all recipients.

Dowson & Mason, Limited

The Manchester firm of Dowson & Mason, Limited, came into existence by the amalgamation of two much older companies, the Dowson Economic Gas and Power Company of London, founded, it would appear, about 1880, and the Mason Gas Plant Company, founded in 1870. A booklet issued by Dowson & Mason to commemorate its golden jubilee is the nearest approach to a personal introduction to the company. It quotes the personnel who receive visitors or handle enquiries and lists their 'phone extension numbers. Other useful information includes a note on parking facilities near the works, suitable trains to catch and where to alight and so on. In 22 pictures are shown the various products made by the company—mainly furnaces for crematoria, heat-treatment (including stress-relief furnaces), melting and vacuum melting. This celebration has been combined with a sales effort.

Industrial Safety Poster Awards

The final judging in the annual Safety Poster Competition, held by the Distillers Company, Limited, took place in London last month, when four entries were chosen for reproduction and use throughout the company during 1960. The competition, the subject of which was "Safe Handling," was open to the 10,000 employees in the D.C.L. group. The final selection was made from the 33 local prize-winners by a panel headed by Sir George Barnett, consultant to the company on safety matters, assisted by representatives of the D.C.L. personnel, safety, productivity and publicity departments. The prize-winners were:—(1) Mr. S. G. Jones, main stores department, British Resin Products, Limited, Barry, Glam. (£20); (2) Mr. H. Douglas, safety equipment storeman, D.C.L. chemical division, Hedon, Hull (£10); Mrs. P. A. Doyle, laboratory assistant grade I, antibiotics division, D.C.L. research & development department, Epsom (£5), and (4) (extra award) Mr. C. Squires, fitter mechanic, Tanqueray, Gordon & Company, Limited, London (£3).

TRIPLEX FOUNDRY, LIMITED, Great Bridge, Tipton, Staffs, through its subsidiary, Vowles Aluminium Foundry Company, Limited, is arranging to take over all the issued capital of Vowles Brothers, Limited, from Duport, Limited, Tipton.

Personal

Mr. J. A. METCALFE has been appointed a director of Minerals Separation, Limited.

Mr. C. H. T. WILLIAMS has been appointed a director of the Steetley Company, Limited.

Mr. K. BAIRD has been appointed personnel manager of F. Perkins, Limited, diesel-engine manufacturers, Eastfield Factory, Peterborough.

Mr. H. G. HERRINGTON, managing director of High Duty Alloys, Limited, has been re-elected chairman of the Aluminium Industry Council.

Mr. J. STANLEIGH TURNER has been re-elected president of the Coal Utilisation Council for the twelfth year in succession. Sir JOHN CHARRINGTON has been re-elected vice-president.

Mr. C. BIRDSALL, an employee of the Piston Ring & Engineering Company, Limited, Leeds, has received a presentation of a gold watch to mark his 25 years' service with the company.

Mr. WILLIAM EVANS, salvage officer at Edgar Allen & Company, Limited, Sheffield, and the firm's longest-serving employee, has retired from the firm. He received retirement presentations on December 30.

Glenfield & Kennedy, Limited, announce the following appointments to the board of the company:—Mr. JOHN H. LAWRENCE; Mr. DONALD A. S. MACLELLAN; Mr. JAMES C. ROBERTSON and Mr. JAMES G. WORKMAN.

In recognition of his 25 years' continuous service with Hall & Pickles, Limited, Sheffield, Mr. ERIC M. GIDNEY, assistant melting shop manager, has received a presentation from the managing director, Mr. J. H. Russell.

Mr. R. P. S. BACHE, a past-president of Birmingham Chamber of Commerce, has been invited by the President of the Board of Trade to represent the National Union of Manufacturers on the new Export Publicity Council.

Mr. E. T. JUDGE, assistant managing director of Dorman Long (Steel), Limited, has been appointed joint managing director of the company, and an executive director of the parent, Dorman Long & Company, Limited.

Five employees, Mr. JOHN BROWN, Mr. ROBERT DAVIE, Mr. JAMES MCMILLAN, Mr. JAMES HARD and Mr. JOHN MCKAY, have been presented with medals and gifts in recognition of 50 years' service with the Southbank Iron Works, Kirkintilloch.

Mr. GRAHAM M. WELLS, sales director of Hopkinsons, Limited, valve manufacturers, Birkby, Huddersfield, has been appointed assistant managing director. Formerly a representative in the London area, then London office manager, Mr. Wells was appointed a director in 1955.

The second longest serving employee at H. & J. Hill (Willenhall), Limited, Mr. THOMAS MORGAN, has been presented with a gold watch to mark his completion of 50 years' service. The watch, suitably inscribed, was presented on behalf of the directors by the chairman, Col. C. A. B. Lindop.

Two members of the staff of Belliss & Morcom, Limited, Birmingham, have retired after more than 50 years' service. Mr. JAMES FINLAY, who is in charge of the maintenance of buildings, leaves after 55 years' service, and Mr. J. TILLY, a draughtsman, retires after 52 years' service with the company.

Dr. R. C. G. WILLIAMS, PH.D., B.SC.(ENG.), A.C.G.I., D.I.C., M.I.MECH.E., M.I.E.E., chief engineer of Philips Electrical, Limited, is among the distinguished scientists and engineers who form the board of the newly-created College of Technologists set up under the auspices of the National Council for Technological Awards.

BILSTON FOUNDRIES, LIMITED, Bilston, Staffs, has appointed Mr. MERVIN DENTON ISHMAEL, a West Indian, as personnel officer. The appointment has been made in the interests of industrial relations as the company employs some 200 West Indians. Mr. Ishmael is a graduate in industrial relations and social science of the London School of Economics.

On New Year's Day, Mr. F. W. E. SPIES, of Holland, assumed the office of president of the International Committee of Foundry Technical Associations. He replaces Dr. Dacco of Italy. This will be the second time that Mr. Spies has held this office, the last time being a few years after the last war. He is an honorary member of the Institute of British Foundrymen.

At the annual meeting of the *Association Technique de Fonderie de Belgique* the outstanding services rendered to the Association by Mr. RENE DEPREZ was recognized by the award of the Association's gold medal. For 30 years Mr. Deprez has served the Association in many capacities, first as honorary secretary and later as president. The presentation was made by the ruling president, Mr. Robert Doat.

Sir GEOFFREY CROWTHER has been appointed a director of the British Aluminium Company, Limited. Sir Geoffrey, who was editor of *The Economist* from 1938 to 1956, is deputy chairman of *The Economist* newspaper and chairman of the Central Advisory Council for Education (England). He is also on the boards of several companies including the Commercial Union Assurance Company, Limited, Trust Houses, Limited, Encyclopaedia Britannica, Limited, and Hazel Sun, Limited.

Mr. E. WEISS, managing director of Foundry Services International, Limited, has been appointed chairman of the company. Mr. A. O. GRUNDBERG has been appointed deputy managing director of the same firm. He was formerly managing director of Sandvik Swedish Steels, Limited, Halesowen, Birmingham. Mr. P. D. NORMAN has been appointed director of Foundry Services, Limited, where he now holds the position of works manager. Mr. B. ROSEN succeeds Mr. Grundberg at Sandvik Swedish Steels.

The Hadfields group of companies, of East Hecla Works, Sheffield, announce that with effect from December 31, at his own request, Mr. T. H. ARNOLD, M.B.E., F.I.M., relinquished his appointments as local director and controller of the research department and also as a director of the subsidiary companies, Hadfields Steels, Limited, and Hadfields Forgings, Limited. Mr. L. G. FINCH, B.MET., PH.D., succeeded Mr. Arnold as local director and controller, Research Department, on January 1. At the same time, Mr. J. A. GRAINGER, M.ENG., was appointed deputy research controller.

Miss I. M. SLADE, information officer of the British Iron and Steel Research Association for many years, has relinquished that post to take on consulting duties in the Association's operational research department at the Battersea laboratories. She will be closely concerned with ergonomic studies, especially in connection with problems involving safety and protective clothing. The distribution of information, handling of enquiries, and the development and exploitation of the results of research, have now been combined into a single unit—development and information services—of which Mr. L. W. STEVENS-WILSON, formerly head of the development and steel user section, will be head.

News in Brief

OVERSEAS REVIEW (Barclays Bank DCO) reports that foundry activity in the Port Elizabeth area is reported to be at peak output, and higher than the comparable level in 1958.

HIGH DUTY ALLOYS LIMITED, announce that on January 1 they closed their Hillington, Glasgow, office and opened a new one at De Quincey House, 48 West Regent Street, Glasgow, C.2.

THE GOVERNMENT OF GHANA has placed a contract totalling over £900,000 with Leyland Motors, Limited, for a fleet of 150 high-capacity buses and spare major units and replacement parts.

THE NATIONAL SOCIETY OF MASTER PATTERNMAKERS announce the admittance of two new members—Barnet Patterns of Barnet, Herts, and W. H. Farrar & Son (Cleckheaton), Limited, of Cleckheaton, Yorks.

AN ORDER FROM INDIA for a sand-suction dredger has been secured by Wm. Simons & Company, Limited, Renfrew. Worth about £1,000,000, the order was obtained in the face of fierce competition, particularly from Dutch and German firms.

THE SOCIETY OF INSTRUMENT TECHNOLOGY and the British Interplanetary Society are to hold a one-day symposium in London on September 1, 1960, during which approximately eight papers will be presented on rocket and satellite instrumentation.

AUSTIN & PICKERSGILL, LIMITED, shipbuilders, Sunderland, have received an order for a sugar carrier of 10,000 tons for Booker Bros., Limited, of Liverpool. They have also received an order for a 18,000-ton ore-carrier for an undisclosed British company.

LEYLAND MOTORS, LIMITED, announce that sales and full-scale servicing of their trucks throughout the United States will be handled by a newly-formed company, Leyland Motors (U.S.A.), Incorporated, a subsidiary of Jaguar Cars, Incorporated, of New York.

AUSTRALIAN MOTOR INDUSTRIES, LIMITED, have stated that the company's sales totalled nearly £A18,000,000 during 1959—£A5,000,000 more than in 1958. Chairman, Mr. Crosby said that sales of Standard Vanguard and Triumph cars went up by 25 per cent.

SHEFFIELD HEALTH COMMITTEE has recommended that an order should be made declaring 522 acres in the Gleadless area the city's next smoke-control area, to come into operation on November 1, 1960. Adaptation of heating appliances on premises in the area will cost £4,370.

A 150-TON ROLL-HOUSING made by the Davy and United Engineering Company, Limited, was dispatched on a four-day road journey from Sheffield to Hartlepools in December. It is for a hot-rolling mill for producing steel plate, planned by the South Durham Steel and Iron Company, Limited.

MERSEYSIDE ENGINEERING (REFRIGERATION), LIMITED, are to build a new factory at Birkenhead for the manufacture of refrigerators. Building starts early this month and it is expected that the new factory will be in operation within six or seven months. Employment will be provided for between 300 and 400 local people.

A MERGER has taken place between two Clyde shipbuilding firms which specialize in the construction of dredgers. They are William Simons & Company, Limited, and Lobnitz & Company, Limited, and in future they will be known as Simons-Lobnitz, Limited. Both firms are subsidiaries of G. & J. Weir, Limited, Glasgow.

A SUBSIDIARY of Metal Industries, Limited, the Hughes Bolckow Shipbreaking Company, Limited, Blyth (Northumberland), has changed its name to Hughes Bolckow, Limited. This gives recognition to the fact that, although its main activity is still in shipbreaking, the company now has other interests, notably in engineering.

THOS. W. WARD, LIMITED, Albion Works, Savile Street, Sheffield, are carrying out a major portion of the demolition in many disused cotton mills in Lancashire and Yorkshire, so that the mill owners can qualify for Government compensation. The work is being done at speed as the qualifying date is the end of March next.

YORKSHIRE IMPERIAL METALS, LIMITED, Leeds, distributed £132,000 among its 6,553 employees in a profit-sharing bonus at Christmas. The bonus was related to the profits made during the year. Every worker who had been in continuous employment with the company for at least six months of the financial year benefited.

TEXAS GULF SULPHUR COMPANY and the International Nickel Company of Canada, Limited, have announced "encouraging results" in the initial eight-months operation of a pilot plant for obtaining pure sulphur from sulphur dioxide in the high-quality roaster off-gas at Inco's iron-ore recovery operation in the Sudbury district of Ontario.

THE STORES DEPARTMENT, South African Railways, is asking for an oil-fired rotary dryer for installation in a large mechanized foundry. Tenders have to be in Johannesburg by January 12. Details are available from the Board of Trade, Export Services Branch, Lacon House, Theobalds Road, London, W.C.1; reference ESB/30119/59.

ORDERS FOR FOUR SHIPS, estimated to be worth about £1,500,000, have been announced by J. L. Thompson & Sons, Limited, Sunderland. Two are for tugs to be built for the Clyde Shipping Company, Limited, Glasgow, and the other orders are for a bulk carrier of 15,000 tons for Norwegian owners and a coastal tanker of 1,550 tons for the Esso Petroleum Company, Limited.

PANTAK, LIMITED, of Vale Road, Windsor, Berks, have recently concluded an agreement with Usines Balteau of Liège for the marketing in the UK of two ranges of lightweight portable industrial X-ray equipment, consisting of two oil-insulated units of 140 and 200 kv capacity, and three gas-insulated units of 150, 180 and 300 kv capacity. The 180 kv unit has been specially developed for the examination of circumferential welds, etc.

THE LONDON OFFICE of the British Welding Research Association is now at 19, Fitzroy Square, W.1 (telephone: EUSton 9595/6). The office will contain the committee meeting room, membership and liaison staff, and secretarial and accounts staff. The research sections, research committee secretariat, design advisory service, library, and publications section are at Abington Hall, Abington, Cambridge (telephone: Linton 375 and 388).

THE BOARD OF TRADE, quoting an official source, states that a new undertaking, M/S Hind Overseas (P), Limited, 7, Narain Prasad, Babu Lane, Calcutta, 7, which is to manufacture about 20,000 tons of grey-iron castings per year, has received a licence to carry on. Inquiries about this development should be addressed to the Export Services Branch of the BoT, Room 705, Lacon House, Theobalds Road, London, W.C.1, quoting reference ESB/27587/59.

STEEL, PEECH & TOZER, a branch of the United Steel Companies, Limited, are to spend over £400,000 on the modernization of their semi-continuous bar mill. Work has begun on the scheme, which is due for completion by August, 1960. The main contractors are the Brightside Foundry and Engineering Company, Limited, Sheffield, while the electrical equipment, including the motors and rectifiers, will be supplied by Associated Electrical Industries, Limited, Rugby.

FOUNDATION STONE of a three-storey technical research building for Pollard Bearings, Limited, Ferrybridge (Yorks), was laid recently by the daughter of Mr. John L. King, the managing director. Mr. E. G. Jones, the company's technical manager, said that the company was hoping to adapt the cold-forming process to production of bearing rings. This would mean that they could be produced up to 60 times as fast as present techniques allowed, he said.

BRUCE PEEBLES & COMPANY, LIMITED, Edinburgh, are soon to begin construction of eight rectifier transformers for the Harwell establishment of the UK Atomic Energy Authority, while special low-frequency power-supply equipment has been ordered for the control rod section of the North Wales nuclear power-station. The company has also concluded an agreement to manufacture under licence American electronic pipe-finding and leak-detecting equipment.

THE AMERICAN JOURNAL *Foundry* reports that the American Meehanite Metal Corporation, New Rochelle, New York, has been bought by Harry H. Kessler and Associates, St. Louis. No change in location or method of operation is planned, and Meehanite will continue to operate as a separate company. Mr. Harry H. Kessler will become president of the company; Mr. Oliver Smalley who has sold his interest in Meehanite Metal remains with the Corporation as consultant. He also retains his interest in other Meehanite companies.

CARD CLOTHING AND BELTING, LIMITED, of Halifax, have concluded arrangements to acquire the issued capital of Francis Birkett and Sons, Limited, brass-founders and engineers, of Cleckheaton. Mr. A. F. Firth, chairman of Card Clothing and Belting, Limited, will become chairman of the new company, with Mr. Arnold Birkett and Mr. Francis W. Birkett as joint managing directors. Mr. J. A. Wright, joint managing director of Card Clothing and Belting Limited, will also join the board, together with Mr. Ronald Varley, who will be secretary.

Mr. HAROLD HUMPHRIES, managing director, Hadfields, Limited, East Hecla Works, Tinsley, Sheffield, when presenting clocks to 20 employees to mark their 25 years' service with the firm, said that with the later school-leaving age it was going to be extremely difficult for men to put in the 50 years necessary for membership of the Jubilee Association, and the directors might have to think of a grade of service between 25 and 50 years. The firm's 25 Association was formed in 1952 and had an initial membership of 1,157; its present membership is 1,449.

THE NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD have placed orders for turbo-generating plant for their power stations at Livishie, Glenmoriston, Invernessshire and at Loch Glashan, Loch Fyneside, Argyll, with the Harland Engineering Company, Limited, Alloa, and Associated Electrical Industries, Limited. The former company will supply Francis turbines for the Livishie and Loch Glashan power stations, and will also supply and install the main valve and associated equipment at Livishie. The heavy plant division of AEI will supply two generators, one of 15,000 kw, and the other of 6,000 kw.

DRAUGHTSMEN employed at the Sheffield works of Hadfields, Limited, and Millspaugh, Limited, did not return to work on December 28 after the Christmas holidays. They struck for a minimum weekly wage of 15 guineas at the age of 25, and are supported by the union of the Association of Engineering and Shipbuilding Draughtsmen. About 100 men are involved. Fourteen days' notice of their intention to strike had been given. Other Sheffield firms have rejected the Association's pay claim, but only the draughtsmen at the associated companies of Hadfields and Millspaugh decided to strike.

THE BRITISH PETROLEUM COMPANY have produced oil from three of the six bores being drilled by them in the Gainsborough district of Lincolnshire, and natural gas, the first in the district, has been produced from two. One of the bores, at Yawthorpe, four miles from Gainsborough, is producing nine tons of oil a day in commercial quantities. At a bore in the Gainsborough town area, on the Corringham road, oil was found at 3,300 ft. and 4,300 ft. and gas at 4,700 ft. The gas is likely to yield 100,000,000 cub. ft. per day. A bore in a recreation field at Gainsborough is down to 5,000 ft. and is expected to produce a record yield when tapped.

BROOK MOTORS, LIMITED, Huddersfield, are again employing home winders. At present 20 women are engaged and it is hoped to increase the number. It is reported in the firm's house magazine that more labour is being taken on and, though overtime is being worked at all factories, it is insufficient to meet the needs of the company if large contracts recently obtained were to be met and delivery dates honoured. Orders have been received from Eastern Europe, Burma, India, Persia, New Zealand and Canada. The Brooks Motor Corporation in the United States has placed a contract for more than 50,000 dollars worth of motors over and above their regular shipment.

DERI (ENGINEERS), LIMITED, Sussex, and Hydrobel, S.A., Sclessin-Liege, Belgium, have been acquired by Brakeshoe International S.A., a wholly-owned subsidiary of the American Brake Shoe Company, New York. Both companies are designers and producers of hydraulic and pneumatic components and systems, for the western European market. The firms will continue to manufacture their own products and will also manufacture in Europe, American Brake Shoe Company's line of industrial hydraulic pumps, motors, presses and controls. No changes in their organization are contemplated. In addition to Mr. Charles S. Prendergast, Deri's board of directors will include Major John Fermor-Hesketh and Mr. J. S. Wyman.

MORE EMPLOYMENT should result from developments now taking place at the Guisborough, North Yorks, foundry of Blackett Hutton and Company, Limited, the managing director, Mr. J. Currie, said when presenting long-service awards to 21 employees at Blackett Hall, Guisborough. A new fettling shop was expected to be completed in the middle of 1960, which would replace two shops now in use, and make way for modernization of the foundry. Mr. Currie said he hoped the men would accept the new methods and that they would give the same co-operation as was being experienced at present. He added that although the last 18 months had been difficult, there had been in the past two months an upward trend which he hoped would continue. Since 1950 when the company decided to reward long service with presentations, there had been many recipients, the total of their service being 4,000 years.

Raw Material Markets

Iron and Steel

Generally ironfounders were able to start the New Year with good order-books and the prospect of a continuation of business at least at present levels for some time to come. Many of the trades for which they cater are operating at full capacity and others which have not been so busy are showing signs of revival. Included among the foremost consumers indenting for substantial tonnages of castings are the motor-vehicle industry, heavy engineering and electrical plant manufacturers, steelworks, agricultural implement makers, and the machine-tool trade, which is stepping up its demands. High-duty castings are chiefly in demand and, comparatively, the call for these is much heavier than for other grades.

For some time none of the foundries has been more heavily employed than those catering for the motor-vehicle trade and the boom in this industry ensures a continuation of high-pressure demand. The steelworks' requirements for castings and ingot moulds have also increased considerably. In recent months many of the light foundries have been able to obtain higher outputs from the increased demand for castings from the domestic utensil manufacturers and also from the building trades. Most of the jobbing foundries are fairly well employed, but the textile foundries are badly in need of more business.

In the supply of pig-iron the heavy usage of the low-phosphorus irons continues to absorb fully all available supplies. Stocks previously held by producers have been disposed of. Outputs are covered by the orders on hand, and these, in many instances, are limited in tonnage by allocation. Early this year additional furnace capacity is expected to be available for the production of the low-phosphorus iron, and this should ease the present difficult supply position. Hematite makers are also much busier and are able to dispose of appreciable tonnages from stocks and outputs, while the refined-iron producers find demand increasing.

The improved call for high-phosphorus irons is being met satisfactorily and the furnaces could cope with increased business to enable them to reduce stocks and absorb outputs fully. Buyers abroad continue to accept consignments.

There is a growing demand from the foundries for cast iron and steel scrap, particularly for the better and heavier grades of cast-iron scrap, which is readily accepted as parcels become available. Foundry coke continues to be delivered in adequate quantities and ganister, limestone, and firebricks are available on demand.

The re-rollers began the New Year with a good demand for all their products and are assured of production at high levels for some time ahead. The heavy call for small bars, light sections, and reinforcing rods is maintained.

The supply of steel semis continues difficult, and the re-rollers are working hand-to-mouth on present deliveries which are below consumption and stock requirements. Many of the steelworks are committed some months ahead for their outputs. All arisings of suitable re-rolling quality defectives and crops are readily accepted.

Non-ferrous Metals

The US copper position is still confused. The present situation is that of the big three producers, Anaconda, Phelps Dodge, and Kennecott, only Anaconda has come to any agreement with the International Union of Mine, Mill and Smelter Workers. Even so, the agreements are not yet complete. For while production has been resumed on the company's properties in Arizona, Nevada, and New Mexico, the resumption of mining at Utah—the most important property—cannot take place until further negotiations, which are now taking place, reach a successful conclusion.

The London market can therefore still regard the US industry as being strikebound. This is more or less the face presented by the present LME quotations, which have yet to react to the complete settlement of the US copper strike. Meanwhile, prices could go much higher if the overall settlement is delayed much longer. In London the cash price is at a premium of approximately £15 a ton over three months' metal. This backwardation ought to close noticeably once the US strike is settled. In the US custom smelters are quoting 35 cents and producers 33 cents a pound.

Tin markets in both sides of the Atlantic have been suffering from the US steel industry strike, and the news of the settlement came as a great relief. Demand has been satisfactory in London and a backwardation has been maintained.

Lead is a much better market in London than in New York. In London and on the Continent, nearby metal is in short supply and the resulting backwardation has raised the whole price level. In the US the price is now down to 12 cents a pound and there are large stocks overhanging the market.

Zinc is a good market. This is in spite of the Board of Trade releasing 3,000 tons of metal in January with the possibility of further releases later. The nearby position has eased somewhat, although the backwardation continues around £5 a ton. The US market is fairly good, with the price firm at 12½ cents a pound.

Obituary

The death has occurred at the age of 79 of Mr. ARTHUR PERCY HARROP, head of the stove-grate company of Yates, Haywood & Company, Limited, Rotherham.

The death has occurred, at the age of 60, of Mr. THOMAS JAMES SMITH, former assistant chief maintenance engineer at the Riddings Works of the Stanton Ironworks Company, Limited.

Mr. HAROLD BENNETT, who was mayor of Lincoln in 1944-45, died last week, a few days before he was due to retire from his position as factory relations officer to Robey & Company, Limited, the Lincoln engineers and boilermakers, etc. He joined Robey & Company after the last war and previously spent many years with the Clayton Dewandre Company, Limited, motor engineers, etc., also of Lincoln.

Mr. THOMAS BABINGTON MACAULAY, a former director of P. & W. MacLellan, Limited, engineers and iron and steel merchants, Glasgow, has died. Beginning as an apprentice engineer with the firm in 1905, he became works manager in 1919, general manager in 1934, and a director of the company in 1940. He retired two years ago. He was a former chairman of the Scottish branch of the Institution of Structural Engineers.

European Foundry Apprentice Competition

At the last meeting of the European Committee of Foundry Associations, held in Luxembourg, the following programme for the European Foundry Apprentice Competition was established. This year the competition will be held in England; in 1961, in Germany; 1962, Italy; 1963, Austria, and 1964, in either Holland or Belgium.

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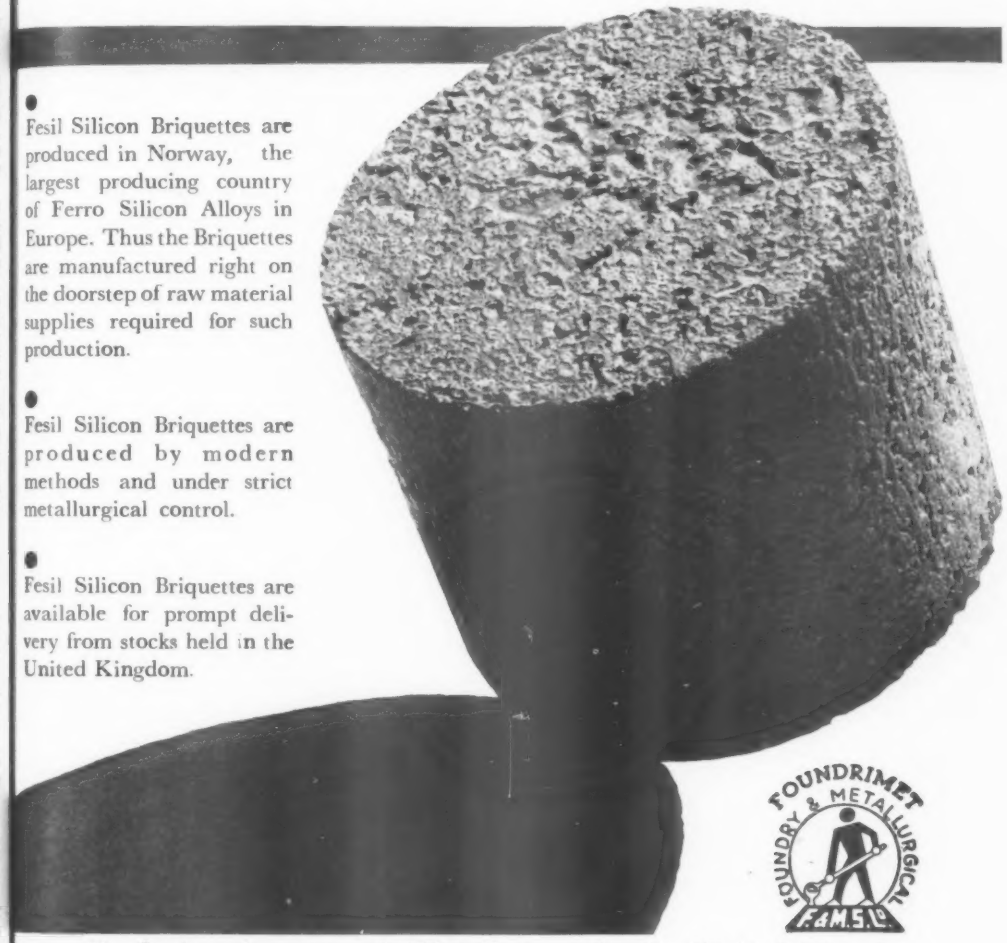

- Fesil Silicon Briquettes are produced in Norway, the largest producing country of Ferro Silicon Alloys in Europe. Thus the Briquettes are manufactured right on the doorstep of raw material supplies required for such production.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

January 6, 1960

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2, 10-ton lots or over: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.40 per cent. P, 10-ton lots or over, £23 5s. 0d., delivered Birmingham, £23 10s. 0d., delivered Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 6s. 6d.; South Zone, £25 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.: North Zone, £26 6s. 6d.; South Zone, £26 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent., 10-ton lots or over: N.-E. of England (local iron), £24 14s. 0d.; Scotland (Scotch iron). Zone S.1, £25 0s. 6d.; Sheffield, £26 2s. 6d.; Birmingham, £26 9s. 0d.; Wales (Welsh iron), £24 14s. 0d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leicestershire in 10-ton lots or over.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £41 10s. 0d. to £44 0s. 0d., scale 15s. 0d. per unit, lumpy; 75 per cent. Si, £57 0s. 0d. to £62 10s. 0d., scale 15s. 0d. per unit, lumpy.

Ferro-vanadium.—50/60 per cent., 22s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

Ferro-tungsten.—80/85 per cent., 11s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 7d. per lb. of W.

Ferro-chrome (6-ton lots and over, lumpy).—4/6 per cent. C, £78 10s. 0d. to £82 10s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 28s. 6d. per unit; over 6 per cent. C, £77 0s. 0d. to £80 10s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 28s. 6d. per unit; 2 per cent. C,* 1s. 8d. to 1s. 11d. per lb. Cr; 1 per cent, C,* 1s. 8½d. to 1s. 11½d. per lb. Cr; 0.15 per cent. C.* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.10 per cent. C,* 2s. 0¾d. per lb. Cr; 0.06 per cent. C.* 2s. 1d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 10d. per lb.

Metallic Manganese.—94/96 per cent., carbon-free, £245 0s. 0d.; 96/98 per cent., £275 0s. 0d.

Ferro-columbium.—65/67 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

Ferro-manganese (Standard).—78 per cent., £63 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft u.t., 100 tons & over, £31 15s. 6d.; tested, 0.08 to 0.33 per cent. C, 6 to 35 tons, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), under 10 tons, £34 17s. 0d.; silico-manganese, under 10 tons, £43 16s. 6d.; free-cutting, under 10 tons, £36 14s. 6d. SIEMENS MARTIN ACID (under 10 tons): Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

Billets, Blooms, and Slabs for Forging and for Stamping (under 10 tons).—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

* Average 68–70 per cent.

FINISHED STEEL

Heavy Plates and Sections (under 10 tons).—Ship plates (N.-E. Coast), £42 2s. 0d.; boiler plates (N.-E. Coast), £44 12s. 0d.; floor plates (N.-E. Coast), £43 11s. 0d.; angles (N.-E. Coast), £39 16s. 6d.; joists (N.-E. Coast), £39 12s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in. and flats 5 in. wide and under, untested soft basic, 50 tons and over, £39 1s. 0d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, 100 tons and over, £38 0s. 0d.; uncoated strip mill coils, hot rolled, under 3 mm. to 12g., 25 tons to under 50 tons, £43 16s. 0d.; black sheets (hand mill), 24g., 10 tons and over, £57 14s. 6d.; galvanized corrugated sheets, 24g., 10 tons and over, £68 5s. 0d.

Alloy Steel Bars.—1 in. dia. and up; Nickel, £68 10s. 0d.; nickel-chrome, £99 4s. 0d.; nickel chrome-molybdenum, £111 17s. 0d., in lots of 5 tons to under 10 tons.

NON-FERROUS METALS

Copper.—Cash, £254 0s. 0d. to £254 10s. 0d.; three months, £242 5s. 0d. to £242 10s. 0d.; settlement, £254 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 5½d. per lb.; rods, 271s. 6d. per cwt. basis; 20 s.w.g., 306s. 6d. per cwt.

Tin.—Cash, £788 10s. 0d. to £789 0s. 0d.; three months, £784 10s. 0d. to £785 0s. 0d.; settlement, £789 0s. 0d.

Lead (Refined Pig).—First half January, £74 12s. 6d. to £74 17s. 6d.; first half April, £73 12s. 6d. to £73 17s. 6d.

Zinc.—First half January, £95 10s. 0d. to £95 12s. 6d., first half April, £90 10s. 0d. to £90 12s. 6d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £130 10s. 0d.; rolled zinc (boiler plates), all English destinations, £128 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £107 10s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 0½d. per lb.; sheets to 10 w.g., 220s. 9d. per cwt.; wire, 2s. 10½d.; rolled metal, 220s. 9d. per cwt.

Brass (Brazing).—BS1400, B3, £163; B6, £215.

Brass (High Tensile).—BS1400, HTB1, £195; HTB2, £211; HTB3, £231.

Gunmetal.—BS1400, LG2, £204; LG3, £214; G1, 1½%, £268; G1, 1%, £255.

Phosphor Bronze.—BS1400, PB1 (AID released), £304; BS1400, 90/10/1, £290.

Leaded Phosphor Bronze.—BS1400, LPB1, £223.

Phosphor Bronze Strip, etc.—Strip, 310s. 0d. per cwt.; wire, 4s. 3½d. per lb.; rods, 3s. 6½d.; tubes, 3s. 6½d.; chill cast bars; solids 3s. 5¾d.; cored 3s. 6¾d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 0d. per lb.; round wire, 10g in coils (10 per cent.), 4s. 5d.; special quality turning rod, 10 per cent. ½ in. dia., in straight lengths, 4s. 4d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 0d. to 2s. 3d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £71 10s. 0d. to £72 0s. 0d. Nickel, £600 0s. 0d. Aluminium, ingots, £186 0s. 0d.; aluminium bronze (BS1400), AB1, £251; AB2, £261.

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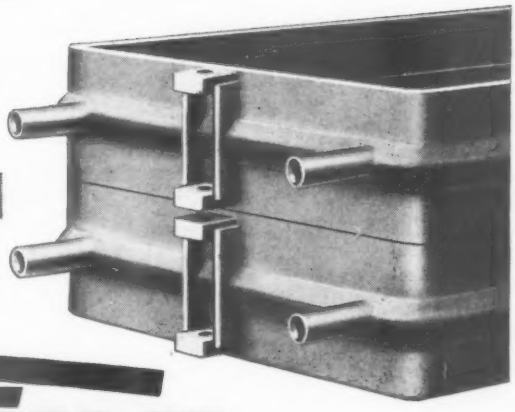

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Company News

Metal Industries offer for Lancashire Dynamo

News of the proposed £9,750,000 bid by Metal Industries, Limited, for Lancashire Dynamo Holdings, Limited, was announced late last month. Metal Industries is the holding company for a group which has interests not only in metals and engineering, but which has recently been expanding in the electrical switchgear and instrument field. Lancashire Dynamo is the holding company for a group of electrical engineering companies. The offer is made on the assumption that there have been no material changes in Lancashire Dynamo's financial position since the end of its financial year on December 31, 1958.

The basis of the offer is £4 new Metal Industries ordinary stock plus 30s. cash for every £5 ordinary stock in Lancashire Dynamo; £6 new Metal Industries 5 per cent. preference stock for every £5 of 5½ per cent. Lancashire Dynamo preference stock. The offer for both classes of stock is subject to acceptance by not less than 90 per cent. by value of the holders of each class and to the necessary approval being given to the increase in the authorized capital of Metal Industries.

Upon acceptance a dividend of 10 per cent. will be paid to Lancashire Dynamo ordinary stockholders to cover the period up to March 31 of this year. The new Metal Industries ordinary will not rank for any final dividend for the year to March 31, 1960, but will rank *pari passu* thereafter.

It is envisaged that the chairman and deputy chairman of Lancashire Dynamo, Lt.-Col. G. S. Marston and the Earl of Halsbury, should join the board of Metal Industries and that Sir Charles Westlake and Mr. J. Black, chairman and vice-chairman of Metal Industries, should join the Lancashire Dynamo board.

EXPERT TOOL & CASE HARDENING COMPANY, LIMITED—There is no dividend on the 6½ per cent. redeemable cumulative preference shares for the six months ended December 31, 1959.

H. W. KEARNS & COMPANY, LIMITED, machine-tool makers, of Altrincham (Ches)—Sir Lionel Kearns, chairman, said at the annual meeting last month that the improvement in the last part of the financial year had continued. The tendency was for the rate of order booking to rise. There were more inquiries, he said, and the position was healthy.

HUNSLET (HOLDINGS), LIMITED—The company, which was formed in 1958 to amalgamate four subsidiaries, the principal being in the locomotive building industry, announces a dividend of 7½ per cent. for the year to July 31, 1959, as forecast when the shares were introduced to the market. Group net profit is £37,361 (£103,951) after tax of £34,600 (£106,180).

FREDERICK BRABY & COMPANY, LIMITED, structural engineers, manufacturers of metal plate and sheet metal work, etc., of London, N.W.1—Dividend for the year ended September 30, 1959, is maintained at 5 per cent. Trading profits fell to £57,320 (£353,321), there was no tax, compared with £5,943 the previous year, and the net loss amounted to £172,576, against a profit of £69,544.

JOB WHEWAY & SON, LIMITED, manufacturers of pulley-block chains, of Walsall (Staffs)—A recent extra-ordinary meeting approved the merger with Watson & McLean, Limited, the Glasgow chainmakers, and the name of the company has been changed to Wheway, Watson & McLean, Limited. All the Watson & McLean shareholders accepted the share exchange offer.

Firth Cleveland to acquire Solartron Group

Controlling interest in the Solartron Electronic Group, Limited, designers and manufacturers of electronic and scientific instruments, of Thames Ditton (Surrey), is to be acquired by the Firth Cleveland Holding & Investment Company, Limited, one of the largest and most rapidly expanding British industrial holding companies.

According to the terms announced on December 29, Firth Cleveland will subscribe for 300,000 new ordinary shares of 10s. each at £3 per share, to raise £900,000, and will acquire from existing holders 125,000 ordinary 10s. shares, the consideration per Solartron share being at the option of the holders, either £3 in cash or the allotment of two Firth Cleveland 4s. ordinary shares. The value of the offer could amount to just under £1,500,000. After the acquisition Firth Cleveland will hold 53,125 per cent. of the Solartron issued ordinary capital of 800,000 shares. Firth Cleveland has undertaken to make a further offer on or before July 31, 1961, for the Solartron ordinary shares not owned by it.

Solartron's long-term expansion programme has required a steadily increasing amount of new finance each year—research expenditure absorbs about 15 per cent. of the value of sales—and the directors decided some time ago that a sum approaching £1,000,000 should be raised immediately. The introduction at this stage of an industrial partner who could provide not only the finance, but also trading benefits, was considered the best way of raising the money.

It is proposed that Mr. Charles Hayward, chairman of Firth Cleveland, and Mr. Gordon Harries, its secretary, be appointed to the Solartron board, and Mr. Hayward has agreed to accept the chairmanship of the board, with Mr. John Bolton, the present chairman, as deputy chairman. An extra-ordinary meeting of the Solartron Electronic Group will be held on January 14.

Machine-tool Orders

Value of new orders for machine tools placed with the UK industry, particularly in the home market, rose sharply in September. The total value of both home and export orders was over £10,000,000, an improvement of more than £4,000,000 on the previous month and shared equally between home and overseas business.

September was the second month running for an increase in the total order-book to be noted—from £49,280,000 to £52,490,000, compared with £59,160,000 a year earlier. During the same month deliveries also rose sharply—to £7,000,000—but this was partly a consequence of the resumption of work after the holidays. The net value of new orders for September—£7,744,000—was the highest for any month since November, 1954. The export order-book was increased by £1,000,000 to just over £15,000,000. Shipments to foreign markets amounted to £1,400,000.

On the whole, the pattern of present demand for machine tools conforms closely to the general features of manufacturing industry. The companies making refrigerators, cleaners, and other light-engineering products are supplying a substantial part of current orders, but the aircraft industry and most heavy industries are not yet in the market for new machines to any noticeable extent.

ABOUT 200 CHILDREN were entertained on the Saturday before Christmas by the staff of the Tame Bridge foundry of W. & T. Avery, Limited.

Board Changes

BRITISH THOMSON-HOUSTON COMPANY, LIMITED—Mr. E. S. Little has retired from the board of the company and certain associates.

LAPORTE INDUSTRIES, LIMITED—Mr. H. E. Farmer, who has been appointed a director, will remain secretary of the company.

PRIESTMAN BROS., LIMITED—Mr. Sydney H. Priestman has been elected president on his retirement as chairman. Mr. Phillip D. Priestman has been appointed chairman and managing director.

AUTOMOTIVE PRODUCTS COMPANY, LIMITED—Mr. E. Beaumont and Mr. S. M. Parker have been appointed deputy managing directors of the Automotive Products groups in addition to Mr. A. C. Burdon.

UNIVERSAL GRINDING WHEEL COMPANY, LIMITED—Mr. Michael G. H. Brown has been elected chairman in place of Sir Samuel Beale, who left the chair after the annual meeting, but will continue as a director.

VICKERS-ARMSTRONGS (ENGINEERS), LIMITED—Mr. A. E. Reddell has been appointed a director and to the office of director-in-charge, Weymouth Works. Mr. F. A. E. Pritchard has been appointed a special director and to the office of general manager, Weymouth Works.

WOODALL-DUCKHAM CONSTRUCTION COMPANY, LIMITED—Mr. H. Kerr, director-in-charge of the company's operating department, has retired from that appointment and also from the board. Mr. Kerr joined the staff of the company in 1929 and throughout his service has been associated with plant operation. He held the position of head of the operating department for the past 20 years and joined the board in 1949.

Changes of Name

Among companies which have recently changed their names are those listed below. The new titles are given in parentheses.

YALLOP WEIGHBRIDGE COMPANY, LIMITED, Witham, Essex (Witham Weighbridge Company, Limited).

NORTH HYDE (COMPONENTS), LIMITED, 162, Uxbridge Road, London, W.13 (Elmwood Enamellers, Limited).

CITY ENGINEERING COMPANY (BOREHAMWOOD), LIMITED, 12, Buckingham Street, London, W.C.2 (Citenco, Limited).

S. & D. J. THEWLIS, LIMITED, ironfounders, etc., of Bottoms Foundry, Mossley, near Manchester (Bonova, Limited).

GILBERT & HUNT, LIMITED, manufacturers of gears, etc., of Nile Street, Huddersfield (Highfield Gears, Limited).

BRIGHT STEEL COMPANY (OLDBURY), LIMITED, Castle Street, Tipton, Staffs (Bright Steel Company (Tipton), Limited).

NEW WAY METAL PRODUCTS, LIMITED, 29, Museum Street, London, W.C.1 (New Way Packaged Products, Limited).

NORTON-HARTY ENGINEERING COMPANY, LIMITED, Central Works, Great Bridge, Tipton, Staffs (Norton-Harty (Holdings), Limited).

MICROMETRIC ENGINEERING COMPANY, LIMITED, 11, Underhill Street, Bridgnorth, Salop (Wilson, Pearson (Engineering), Limited).

VINCENT ENGINEERS (STEVENAGE), LIMITED, 34, High Street, Great North Road, Stevenage, Herts (Fishers Green Vendors, Limited).

S. H. HEYWOOD & COMPANY, LIMITED, mechanical engineers, of 1, Brooklands Road, Reddish, near Stockport (S.H.H. Manchester), Limited).

Recent Wills

LAWSON, A. W., a former director of Shell-Mex & B.P., Limited	£55,471
HESKETH, FRANK, formerly chairman and managing director of Isaac Butterworth, Limited, iron founders, etc., of Rochdale	£14,097

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Pig-iron and Steel Production

Statistical Summary of October Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table 1 summarizes activities during recent months. Table 2 gives production of steel ingots and castings in October. Table 3, weekly average production of finished steel in September. Table 4 gives the production of pig-iron and ferro-alloys in October, and furnaces in blast. (All figures are weekly averages in thousands of tons).

TABLE 1.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imported ore used.	Coke sent to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap, used in steel prod.	Steel (inc. Alloy).			
	Iron and steel.	Coal.	Basic materials						Imports.[1]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[2]
1957 ..	328	488	537	325	303	270	275	220	14	417	322	1,444
1958 ..	343	403	478	276	262	227	245	196	9	369	284	1,542
1959—July ..	338	486	472	275	226	201	222	169	7	320	245	1,436
Aug. ..	338	486	479	264	212	193	220	172	5	337	241	1,498
Sept.	338	486	480	288	259	212	251	231	7	426	318	1,467
Oct. ..	339	504	481	298	253	228	270	235	7	441	—	1,444

TABLE 2.—*Average Weekly Production of Steel Ingots and Castings in October*, 1959.

District.	Open-hearth		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derbys, Leics, Notts, Northants, and Essex ..	—	4.8	14.4 (basic)	2.7	0.1	20.5	1.5	22.0
Lancashire (excl. N.W. Coast), Denbighs, Flints, and Ches.	0.8	37.7	—	5.0	0.3	42.4	1.4	43.8
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincs.	—	48.0	—	—	0.1	48.0	0.1	48.1
North-East Coast	1.0	82.4	—	1.3	0.4	83.4	1.7	85.1
Scotland	1.4	42.4	—	3.0	—	45.0	1.8	46.8
Staffs, Shropshire, Worcs, and Warwicks. ..	—	22.2	—	4.3	0.8	25.4	1.9	27.3
South Wales and Monmouthshire ..	2.2	89.1	11.0 (basic)	0.9	0.1	102.9	0.4	103.3
Sheffield (incl. small tonnage in Manchester) ..	8.9	35.7	—	14.0	0.3	57.1	1.8	58.9
North-West Coast	—	—	5.3 (acid)	0.8	—	6.0	0.1	6.1
Total	14.3	362.3	30.7	32.0	2.1	430.7	10.7	441.4
September, 1959[3]	14.0	350.5	29.5	30.3	2.1	416.1	10.3	426.4
October, 1958[3]	14.6	304.6	21.4	20.9	2.0	353.6	9.9	363.5

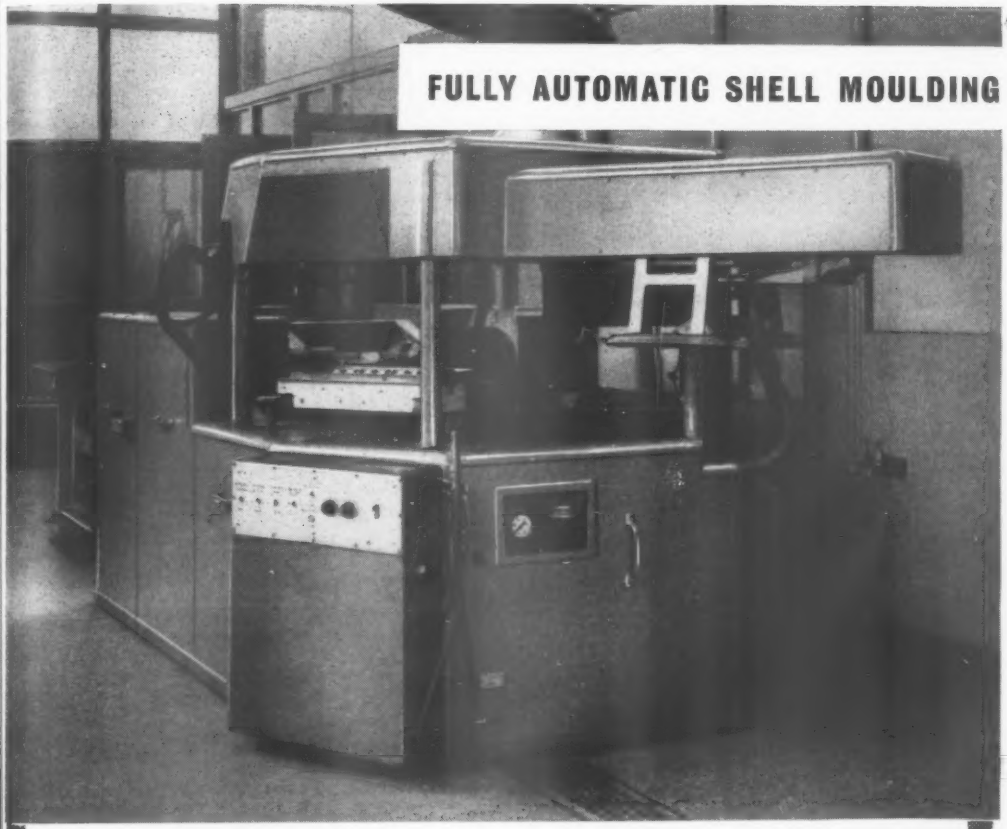
TABLE 3.—*Deliveries of Non-alloy and Alloy Finished Steel.*

Product.	1957.	1958.	1958.	1959.	
			Sept.	August.	Sept.[3]
Non-alloy Steel:					
Ingots, blooms, billets and slabs[4] ..	5.0	4.6	3.8	4.7	5.7
Heavy rails ..	11.2	10.2	9.2	4.0	6.8
Sleepers	1.3	1.2	0.2	0.4	0.5
Fish and soleplates	0.8	0.7	0.9	0.2	0.4
Plates:					
(i) Over ¾in. thick	34.0	29.6	28.7	21.4	26.6
(ii) Under ¾ in. ..	20.3	17.7	17.4	17.6	19.0
Other heavy prod. ..	53.0	41.8	34.9	37.7	48.0
Ferro-concrete bars	8.9	7.6	7.9	8.6	12.9
Wire rods	23.3	21.5	23.3	18.4	24.7
Arches, etc. ..	11.0	8.6	7.8	7.0	7.8
Other light sections	38.7	29.1	29.1	25.9	36.9
Bright steel bars ..	7.0	6.2	6.2	6.4	8.3
Hot-rolled strip ..	23.1	22.6	24.5	19.5	30.1
Cold-rolled strip ..	7.1	7.0	7.2	6.2	9.2
Sheets incl. coated:					
(i) Hot rolled	13.0	10.6	10.9	10.7	14.1
(ii) Cold reduced	29.1	31.1	31.0	32.4	37.5
Tinplate:	18.8	18.7	21.0	11.1	23.7
Blackplate ..	1.0	0.8	0.9	0.3	0.9
Tubes up to 16-in.	22.1	19.0	20.1	16.7	22.5
Tube and pipe fittings	0.5	0.4	0.4	0.3	0.4
Tyres, wheels, axles	5.1	4.5	4.6	1.3	1.8
Forgings(excl.drop)	3.1	2.6	2.7	1.7	2.0
Steel castings ..	4.6	4.2	4.5	2.9	3.7
Tool and magnet steel	0.3	0.2	0.3	0.2	0.2
Total	342.3	300.5	297.5	255.6	343.7
Alloy steel	17.8	16.1	16.5	14.5	18.5
UK production[5] ..	360.1	316.6	314.0	270.1	362.2
Add: Imported finished steel ..	9.6	7.1	5.7	5.9	6.1
	369.7	323.7	319.7	276.0	368.3
Deduct: Intra-industry conversions[6] ..	48.2	41.2	42.1	36.2	51.7
New material ..	321.5	282.5	277.6	239.8	316.6

TABLE 4.—*Production of Pig-iron and Ferro-alloys*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derbys, Leics., Notts., Northants, and Essex ..	17	0.5	22.8	20.2	1.1	—	44.6
Lancs. (excl. N.W. Coast), Denbighs., Flints. and Ches. ..	5	—	21.2	—	—	0.8	22.0
Yorkshire (excl. N.E. Coast and Sheffield) ..							
Lincs.	8	—	40.4	—	—	—	40.4
North-East Coast	16	1.7	52.1	—	—	0.6	54.4
Scotland ..	6	0.6	15.9	0.4	—	—	16.9
Staffs, Shrops, Worcs. and Warwicks. ..	4	—	6.9	1.0	—	—	7.9
S. Wales and Monmouthshire	11	2.2	57.6	1.5	—	—	61.3
Sheffield	2	—	3.1	—	—	—	3.1
North-West Coast	7	17.0	—	0.8	—	1.4	19.2
Total ..	76	22.0	220.0	23.9	1.1	2.8	269.8
September, 1959[3]	75	20.3	204.2	22.6	1.3	2.7	251.1
October, 1958[3] ..	86	21.2	196.1	22.2	0.2	2.2	241.9

[1] Weekly average of calendar month.
[2] Stocks, mainly ingots and semi-finished, at the end of the year and months shown.
[3] Five weeks, all tables.
[4] Other than for conversion into any other form of finished steel listed.
[5] Includes finished steel produced in the UK from imported ingots and semi-finished steel.
[6] Material for conversion into other products also listed in this table.



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SITUATIONS WANTED

REPRESENTATIVE calling on Foundries in the North of England would like to add a number of new lines to his business, only firms producing first quality equipment, supplies or castings need apply to Box RC328, FOUNDRY TRADE JOURNAL.

FOUNDRY SUPERINTENDENT, Australian, 29, with wide experience in Australian malleable, grey iron and electric steel founding industry, together with US experience, seeks management position in UK in similar industry. Box FS307, FOUNDRY TRADE JOURNAL.

WORKS or FOUNDRY MANAGER, age 39, requires position where integrity, initiative and ability to produce first class results will be appreciated. Considerable experience. Practical Technical, commercial and metallurgical training. Floor, mechanised plant, CO_2 and Shell. Diploma Foundry Practice & Technology. A.M.I.Prod.E., M.I.B.F. Genuine replies only please. Interviews welcomed. Reply Box WF314, FOUNDRY TRADE JOURNAL.

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STEEL FOUNDRYMAN, aged 41, desires progressive post preferably methods development. Wide experience modern techniques, CO_2, Shell, etc. Sound knowledge sands. Cost conscious. Box ST315, FOUNDRY TRADE JOURNAL.

NON-FERROUS FOUNDRY MANAGER seeks similar position, wide practical experience and good connections, extensive technical knowledge, used to full control in the production of brass, bronze and high nickel alloy castings, light alloy, sand and gravity die castings, CO_2 and shell moulding process. Box NF323, FOUNDRY TRADE JOURNAL.

METALLURGIST and FOUNDRYMAN, 40, with eleven years in jobbing and mechanised iron foundry and twelve years in large iron and non-ferrous foundry producing aircraft, automobile and general engineering castings, desires change, preferably with smaller foundry where technical knowledge and hard work would be appreciated. Experienced with green sand, dry sand, CO_2, shell moulding, cupola and electric furnace melting and gating of high duty iron, production control, costing and commercial practice. Present salary £1,500. Box MA321, FOUNDRY TRADE JOURNAL.

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MOULDERS and COREMAKERS required for jobbing work up to 1 ton. Ferrous and non-ferrous. Free sickness insurance. Piece work. Will be required to earn over £15 per week. IMPETUS FOUNDRY LTD., Market Street, Maidenhead.

SITUATIONS VACANT—*contd.*

FOUNDRY ENGINEER and DESIGN DRAUGHTSMAN required by Coleman—Wallwork Foundry Equipment Division of Stone—Wallwork Ltd. Applications giving full details of previous experience to be submitted to 32, Victoria Street, S.W.1.

WANTED. A practical ROLLMAKER to take complete charge of a Roll Foundry making Straight Carbon, Molybdenum and Indefinite Chill Rolls also Hollow Rolls. Reply giving full particulars of experience and qualifications also stating salary required. Box AP309, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN aged 30-35 required as FIRST ASSISTANT to FOUNDRY MANAGER at well known progressive non-ferrous foundry in N.W., manufacturing bronze and light alloy castings. A realistic expansion programme is in operation and the appointment calls for a man of character, initiative and ability to control all grades of labour. Box FF317, FOUNDRY TRADE JOURNAL.

TECHNICAL SALES REPRESENTATIVE required for Iron Foundry situated N.E. Applicants must have knowledge of Iron Founding and sales experience, hold current driving licence, age preferably under 35 years. Only those with the necessary qualifications need apply, with full details of experience and salary to:—Box TS304, FOUNDRY TRADE JOURNAL.

ENGINEER REPRESENTATIVE

TECHNICAL SALESMAN with sound engineering background in the light/medium fields required to promote sales of lost wax investment castings in the North of England, where he should be domiciled, and Scotland. Knowledge of this process not essential, but applicant should be familiar with machine shop practice. Some knowledge of steels an asset. Must have previous outside sales experience and live contacts with engineers and designers. Preferred age range 25-35. Details of training, experience and salary required to Box ER322, FOUNDRY TRADE JOURNAL.

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FOUNDRY MANAGER required for well established and expanding Whiteheart Malleable and Cast Iron Foundry near Wolverhampton. Important post requiring an experienced and first class production man for both bench and mechanised moulding. Applicants must be good at organising, trained in cupola and sand control, fully capable of estimating from drawings, used to working on own initiative, not afraid of work and responsibility. Applications for this pensionable position will be treated in the strictest confidence. Reply, stating salary, Box FM313, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

FOUNDRY MANAGER

WELL-KNOWN West Midland Engineering Company is seeking a first class FOUNDRY MANAGER to take full control of two medium sized foundries, ferrous and non-ferrous.

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SALES OFFICE SUPERINTENDENT, preferred age 30-35, required for precision foundry. Previous experience in this work desirable, but a light engineering background would be an acceptable alternative. Applicants should have experience in dealing with customers by phone and correspondence, to be familiar with sales office routine, including preparation of estimates, and to have a high degree of personal efficiency in dealing with detail and a large number of orders. Location 15 miles south of Birmingham. Write, giving details of age, experience and salary required to Box SO327, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

ASSISTANT FOREMAN required for non-ferrous foundry near London. Mainly copper-based alloys. Sound practical experience essential. Willingness to learn, to accept responsibility and to keep good time even more essential. Salary and prospects good. State general experience, age and whether married to Box AF329, FOUNDRY TRADE JOURNAL.

CORE SHOP FOREMAN required by Repetition Foundry in the West Midlands. Must have had experience in the production of large quantities by modern machine methods. Experience in Shell and CO_2 processes would also be an advantage. Please state fully details of experience and salary required. Box CS320, FOUNDRY TRADE JOURNAL.

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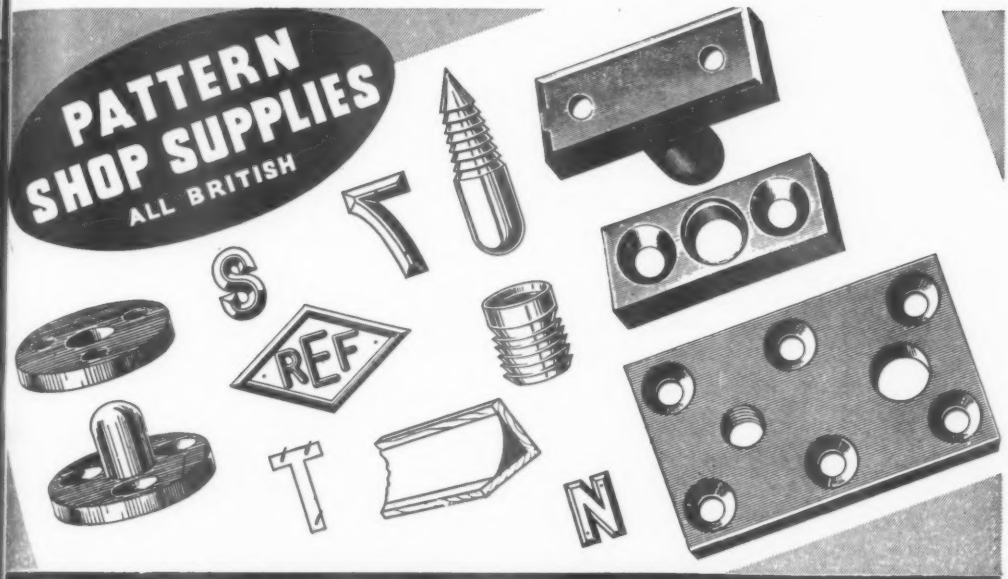

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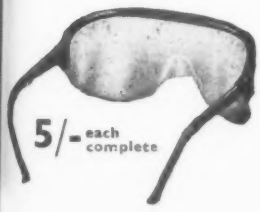

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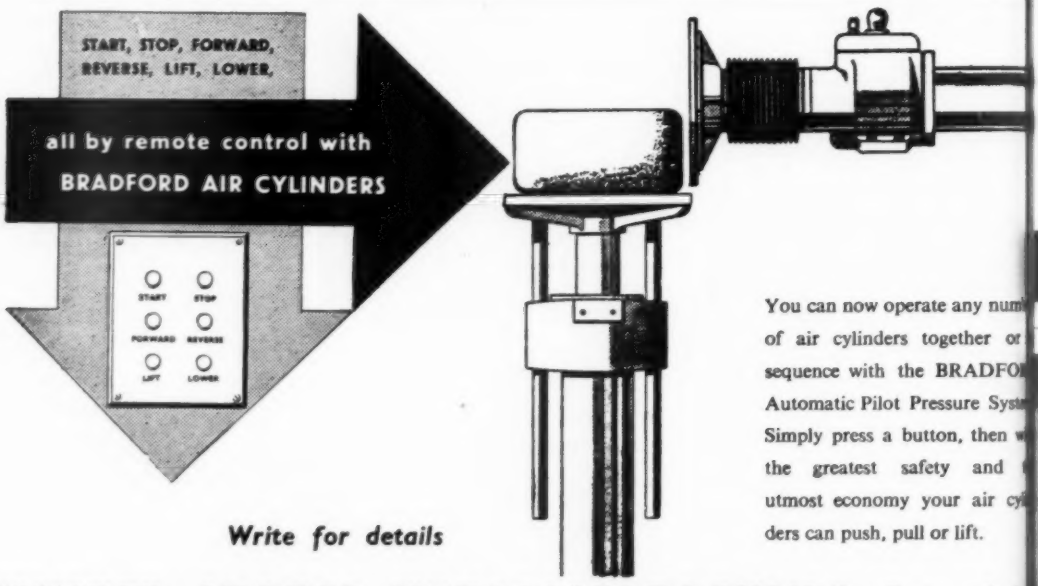

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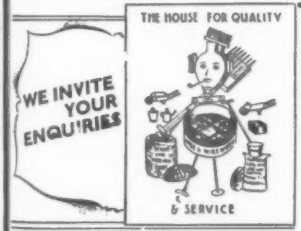

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Alcan (U.K.), Ltd.	—
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Allen, W. G., & Sons (Tipton), Ltd.	—
Alley & MacLellan (Polmadie), Ltd.	—
Anderson-Grice Co., Ltd.	30
Annealers, Ltd.	44
Armstrong Whitworth (M.I.), Ltd.	—
Armstrong Whitworth & Co. (Pneu. Tools), Ltd.	13
Ashworth Ross Co., Ltd.	—
Aske, Wm., & Co., Ltd.	—
Associated Electrical Industries, Ltd. (Motor & Control Gear Division)	—
Ass. Lead Mfrs., Ltd.	—
Association of Light Alloy Refiners, Ltd.	—
August's, Ltd.	36
Austin, E., & Sons, Ltd.	—
Badische Maschinenfabrik A.-G.	—
Bairds & Scottish Steel, Ltd.	—
Bakelite, Ltd.	—
Baker Perkins, Ltd.	37
Balbardie, Ltd.	—
Ballard, F. J., & Co., Ltd.	—
Ballinger, L. J. H., Ltd.	—
Beacon Machine Tools, Ltd.	—
Bennett, H. G., & Co. (Gloves), Ltd.	—
Berk, F. W., & Co., Ltd.	50
Bilston Shot & Grit Co., Ltd.	—
Bilston Stove & Steel Truck Co., Ltd.	—
Birlec-Efco (Melting), Ltd.	—
Birlec, Ltd.	—
B.K.L. Alloys, Ltd.	—
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Block & Anderson, Ltd.	—
Bloomer-Holt Ltd.	—
Boydell, E., & Co., Ltd.	—
Bradbury, John, & Co. (Stockport), Ltd.	47
Bradley & Foster, Ltd.	8
British Acheson Electrodes, Ltd.	—
British Aero Components Ltd.	—
British Electrical Repairs, Ltd.	—
British Foundry Units, Ltd.	—
British Industrial Sand Ltd.	—
British Iron & Steel Federation	—
British MonoRail, Ltd.	—
British Moulding Machine Co., Ltd.	—
British Oxygen Co., Ltd.	11
British Resin Products, Ltd.	—
British Ronceray, Ltd.	—
British Shotblast & Engineering Co., Ltd.	44
Broadwell Engineering, Ltd.	—
Broom & Wade, Ltd.	—
Buckland Sand & Silica Co., Ltd.	—
Burn, John, & Co. (B'ham), Ltd.	43
Busby Bros., Ltd.	—
Carborundum Co., Ltd.	—
Catalin, Ltd.	—
Cawood Wharton & Co., Ltd.	44
Chapman & Smith, Ltd.	—
Ciba (A.R.L.), Ltd.	22
City Casting & Metal Co., Ltd.	—
Clayton Crane & Hoist Co. Ltd.	—
Cohen, Geo., Sons & Co., Ltd.	—
Coleman-Wallwork Co., Ltd.	17
Compagnie Generale des Conduites d'Eau S.A.	—
Consolidated Pneumatic Tool Co., Ltd.	—
Constructional Engineering Co., Ltd., The	—
Controlled Heat & Air, Ltd.	—
Cooke, Bailey, Ltd.	42
Core Binder Manufacturers' Group	—
Cox & Danks, Ltd.	—
Crockett Lowe, Ltd.	—
Cumming, Wm., & Co., Ltd.	47
Cupodel, Ltd.	—
Dallow Lambert & Co., Ltd.	—
Derby & Co., Ltd.	—
Distillers Co., Ltd., The	—
Dowler, H. J., Engineers & Pattern Makers, Ltd.	41
Dowson & Mason, Ltd.	—
Dunford & Elliott, Ltd.	—
Durrans, James, & Sons, Ltd.	16
Dustraction, Ltd.	—
Dustuctor Co., Ltd.	—
Electrical Development Assoc.	—
Electrogenerators, Ltd.	—
Elliott, E., & Co., Ltd.	43
Engineering Services (Manchester), Ltd.	—
Escol Products, Ltd.	—
Evans, James, & Co., Ltd.	—
Evans, Stanley N., Ltd.	—
Evershed & Vignoles, Ltd.	—
Eyre Smelting Co., Ltd.	47
F. & M. Supplies, Ltd.	29
Felco Hoists, Ltd.	—
Fellows & Darby, Ltd.	41
Fischer, George, Ltd.	—
Fisher-Foundries, Ltd.	—
Flextol Engineering Co., Ltd.	—
Fletcher Miller, Ltd.	—
Fordath Engineering Co., Ltd.	29
Foundry Equipment, Ltd.	14 & 15, 27
Foundry Mechanisations (Baillot), Ltd.	—
Foundry Plant & Machinery, Ltd.	33
Foundry Services, Ltd.	—
Foundry Suppliers, Ltd.	—
Foxboro-Yoxall, Ltd.	—
Frankiss, R. J. (Patterns), Ltd.	—
Franklin Furnace, Ltd.	—
Fuel & Metallurgical Processes, Ltd.	2
Fullers' Earth Union, Ltd., The	12
G.W.B. Furnaces, Ltd.	—
Gadd, Thos.	—
Gas Council	—
General Refractories, Ltd.	—
Gietart, N. V.	—
Gilbert, G. & R., Ltd.	40
Gliksten, J., & Son, Ltd.	—
Goodyear Tyre & Rubber Co., Ltd.	—
Green, E., & Son, Ltd.	—
Green, Geo., & Co.	—
Gregory, J. G., & Sons, Ltd.	—
Griffiths, A. E. (Smethwick), Ltd.	18
Guest Keen Iron & Steel Co., Ltd.	—
Harborough Construction Co., Ltd.	34
Hargraves Bros. (Manchester), Ltd.	—
Harris & Pearson, Ltd.	—
Harvey & Longstaffe, Ltd.	—
Harvey, J. J. & Pressurecast, Ltd.	—
Hedin, Ltd.	—
Heneage Metals, Ltd.	46
Hepburn Conveyor Co., Ltd	6
Heywood, S. H., & Co., Ltd.	—
High Speed Steel Alloys, Ltd.	—
Hills (West Bromwich), Ltd.	—
Holmes, W. C., & Co., Ltd.	—
Hooker, Norman (Foundry Supplies), Ltd.	—
Hooker, W. J., Ltd.	33
Hunt, F. L., Ltd.	—
I.C.I. (Billingham Division), Ltd.	—
I.C.I. (Plastics Division), Ltd.	—
Ilford, Ltd.	—
Impregnated Diamond Products, Ltd.	9
Incandescent Heat Co., Ltd.	
Ingersoll-Rand Co., Ltd.	—
Jackman, J. W., & Co., Ltd.	—
Jacks, Wm., & Co., Ltd.	31
Joy-Sullivan, Ltd.	32
Keith-Blackman, Ltd.	—
King, Geo. W., Ltd.	—
Lafarge Aluminous Cement Co., Ltd.	—
Lakin, A., & Son, Ltd.	—
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Leicester Lovell & Co., Ltd.	—
Lennox Foundry, Ltd.	—
Levy, B., & Co. (Patterns), Ltd.	41
Lockheed Precision Products, Ltd.	—
Lones, Joseph Laboratories	47
Lord, E. S., Ltd.	46
Luke & Spencer, Ltd.	—
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Mansfield Standard Sand Co., Ltd.	—
Marco Conveyor & Engineering Co., Ltd.	—
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May, J. H., Ltd.	41
McKechnie Bros., Ltd.	—
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Metalline Cement Co., The	—
Metals & Equipment (Wolverhampton), Ltd.	—
M.G. Plastics, Ltd.	—
Midgley & Son, Ltd.	—
Midland Monolithic Furnace Lining Co., Ltd.	47
Mirrlees Watson Co., Ltd.	—
Modern Furnaces & Stoves, Ltd.	25
Molineux Foundry Equipment, Ltd.	—
Monometer Manufacturing Co., Ltd.	—
Mond Nickel Co., Ltd.	—
Morris, B. O., Ltd.	—
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Platt Metals, Ltd.	—
Pneulec, Ltd.	7
Podmore, W., & Sons, Ltd.	—
Polford Engineering Co. Ltd.	—
Polygram Castings Co., Ltd.	20
Pontifex, H., & Sons, Ltd.	—
Prat-Daniels (Stroud), Ltd.	—
Precision Presswork Co., Ltd.	—
Premo Pattern Co., Ltd.	42
Price, J. T., & Co., Ltd.	—
Production Chemicals (Rochdale), Ltd.	
Purimachos, Ltd.	
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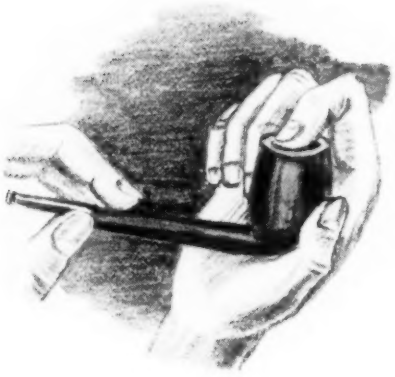

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